National Park Service
U.S. Department of the Interior

Mississippi National River and Recreation Area

Big River Journey Teacher's Guide

grades 4-6

Mississippi River classroom activities
and educational resources

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Big River Teacher's Guide is coordinated by:

Mississippi National River and Recreation Area
(National Park Service)

Additional educational partners include:

Center for Global Environmental Education (Hamline University), Friends of the Mississippi River, Minnesota Department of Natural Resources (Adopt-A-River, Fort Snelling State Park, and Project WET), Minnesota Historical Society (Historic Fort Snelling), Mississippi River Fund, Padelford Packet Boat Co., Saint Paul Audubon Society, Saint Paul Public Schools, Science Museum of Minnesota

2013

Big River Journey
Teacher's Guide 2013

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EDUCATIONAL PARTNERS
BIG RIVER JOURNEY MISSION

**** On disk and online only***

Big River Journey Partners

Big River Journey Coordinator

Mississippi National River and Recreation Area, National Park Service

A 72-mile corridor of river and land extending through the Twin Cities metropolitan area was designated in 1988 as the Mississippi National River and Recreation Area (MNRRA) to represent the national significance of the Mississippi River. MNRRA works with numerous partners to preserve, protect and enhance the historical, cultural, natural, scientific, economic, recreational and scenic resources of the corridor. Big River Journey (BRJ) introduces young students to these resources. On Big River Journey field trips MNRRA staff present learning stations on Mississippi River geology and ecosystems. MNRRA staff provides overall coordination for Big River Journey, Big River Teacher Workshops, Big River Teacher's Guide, and Big River Art Contest.

Additional Educational Partners

Adopt-A-River, MN Department of Natural Resources

Through its Adopt-a-River Program, the Minnesota Department of Natural Resources (DNR) enlists the help of volunteers to clean up, protect and preserve Minnesota's waterways. The program encourages stewardship actions which build watershed awareness within volunteer groups. The DNR's Big River Journey learning station activity about river rubbish and flotsam are an educational first step in drawing new participants into the effort to care for our rivers.

Center for Global Environmental Education, Hamline University

Hamline University's Center for Global Environmental Education (CGEE) is a pioneer on-line environmental education center. CGEE's distance learning programs have included the 1990 Will Steger International Trans-Antarctica Expedition, Journey North and Mayaquest. Current programs include "Waters to the Sea" CD-ROM and "Rivers of Life." These programs use technology to connect students world-wide and to help them undertake hands-on study and stewardship of local environments. At Big River Workshops CGEE staff provides an introduction to using the "Waters to the Sea" CD-ROM. A lab-pack of CD-ROMs may be checked out from the National Park Service (MNRRA) for use by BRJ classrooms.

Big River Journey Partners, cont'd

Fort Snelling State Park, MN Department of Natural Resources

Fort Snelling State Park is situated at the confluence of the Mississippi and Minnesota Rivers. This 3500 acre park was established in 1961 and provides protection for diverse and rare plant and animal communities, including flood plain forests, calcareous fens, oak savanna and prairie. In addition to the park's diverse natural resources, much of the cultural heritage of Minnesota can be traced to this area. The park's Visitor Center includes classrooms and exhibits, and is the site for Big River Teacher Workshops. As part of Big River Journey field trips, some schools start or finish their riverboat trips at the park and participate in experiences with park staff highlighting human and natural history at the confluence area.

Friends of the Mississippi River

Friends of the Mississippi River (FMR) is the leading citizen organization working to protect and enhance the Mississippi River in the Twin Cities area. FMR provides leadership and advocacy to improve water quality, protect wildlife habitat, create educational and recreational opportunities, and inspire widespread commitment to river stewardship. As a partner in Big River Journey, FMR helps teachers and students apply their river learning in their own neighborhood through storm drain stenciling. By connecting students to the Mississippi River and giving them tools to protect water quality by educating others, FMR helps to foster young river stewards.

Historic Fort Snelling, Minnesota Historical Society

The Minnesota Historical Society (MHS) cultivates an awareness of Minnesota history so that people can draw strength and perspective from the past, and find purpose for the future. The Society provides extensive educational services and historical programs at its sites throughout Minnesota. The MHS site of Historic Fort Snelling (HFS), on a bluff overlooking the Minnesota and Mississippi Rivers, was once the northwestern-most outpost of the U.S. Army. Today, this restored stone fortress welcomes you to everyday frontier life of 1827, when laundresses, riverboat captains, fur traders, and the Dakota people all used the river and the boat landing. Participants in Big River Journey trips that connect to HFS will meet one of the many people who inhabited the Fort and explore how they used the river and its resources during the early 19th century.

Big River Journey Partners, cont'd

Mississippi River Fund

The Mississippi River Fund's mission is to strengthen the enduring connection between the people and the Mississippi River by restoring, preserving, and encouraging exploration of the Mississippi National River and Recreation Area (MNRRA). This is done by raising and granting funds in support of MNRRA's education and stewardship programs, increasing awareness of our National Park and the Mississippi River, and making strategic grants to support innovative partnerships. The Fund provides funding support for Big River Journey scholarships and the Big River Student Art Contest.

Padelford Packet Boat Co.

Founded in 1969 by Captain William D. Bowell, Sr., the Padelford Packet Boat Co., Inc. operates three riverboats from their Mississippi River dock at Harriet Island in Saint Paul. Over the course of 40 seasons the Padelford riverboats have introduced more than 3½ million people from all around the world to the Upper Mississippi River. Among each year's passengers are approximately 25,000 students who enjoy narrated field trips on the big riverboats. Since 1996 Padelford riverboats have been utilized for Big River Journey field trips, with nearly 50,000 participants to date. Padelford Co. is a partner in both the planning and delivery of these trips, and presents a learning station on riverboat piloting.

Project WET (Water Education for Teachers), MN Department of Natural Resources

Project WET is an interdisciplinary water education program for formal and non-formal educators of K-12 students. A volunteer facilitator network conducts water education workshops throughout the state. Project WET is based on a nationally circulated curriculum of over 90 hands-on activities. Subject matter ranges from water science to water-related social issues. Selected activities from the *Project WET Curriculum and Activity Guide* provided in the Big River Journey Teacher's Guide are used with permission of International Project WET, 201 Culbertson Hall, Montana State University, P.O. Box 170575, Bozeman, MT 59717-0575. Ph: (406) 994-5392, fax (406) 994-1919. E-mail: projectwet@montana.edu; web site: www.projectwet.org

Big River Journey Partners, cont'd

Saint Paul Audubon Society

Saint Paul Audubon Society promotes exploration and conservation of the natural world. Field trips, birding classes, habitat projects and annual bird counts are their signature activities. This group of active citizens formed in 1945 as the St. Paul Bird Club, but soon changed their name to identify themselves as a local affiliate of the National Audubon Society. Member volunteers lead bird study activities on Big River Journey to highlight evolutionary adaptations, river habitat, binocular skills and wild birds.

Saint Paul Public Schools

One of the largest and oldest school districts in Minnesota, Saint Paul Public Schools (SPPS) provides comprehensive K-12 education for St. Paul's diverse area residents. SPPS Service Learning Program provides SPPS students the opportunity to utilize service-learning as a tool to achieve academic goals and become action oriented citizens. The SPPS District promotes teacher and student involvement in Big River Journey (BRJ). BRJ classroom trunks are available for SPPS teacher use, and SPPS staff members conduct training on service learning for BRJ teachers.

Science Museum of Minnesota

The Education Department of the Science Museum of Minnesota provides youth with diverse opportunities to actively explore all areas of science. A goal is to stimulate in-depth learning through actual investigations, experiments, and creative problem solving experiences. The Science Museum has expanded its river related educational efforts since it moved to the banks of the Mississippi River in 2000. On the Big River Journey trips, Science Museum staff give children the opportunity to examine aquatic invertebrates (insects) through microscopes and to learn of their relationship to water quality.

Big River Journey
Mission

Big River Journey connects students to the science and heritage of the Mississippi River and its watershed, building a foundation for river stewardship.

Description

Big River Journey offers hands-on science and thematic learning opportunities through:

- River field trips
- Teacher workshops
- Classroom activities

Big River Journey strives to include a diverse student audience by recruiting underserved groups and by providing scholarships that support participation.

1.
Science-Based Classroom Activities

Big River Journey
Mississippi River classroom activities
and educational resources

Imagine!

■ **Grade Level:**
Upper Elementary, Middle School

■ **Subject Areas:**
Earth Sciences, Life Sciences, Language Arts, Fine Arts

■ **Duration:**
Preparation time:
10 minutes

Activity time: 20 minutes

■ **Setting:** Anywhere

■ **Skills:**
Gathering information (listening); Interpreting (relating)

■ **Charting the Course**
Prior to this activity, students should learn about physical and chemical processes of water, specifically "Water Models," which covers evaporation and condensation. To support student understanding of the water cycle they can participate in the activity "The Incredible Journey."

■ **Vocabulary**
evaporation, condensation, precipitation

What would it be like to take a journey as a water molecule?

▼ Summary

Students take an imaginary journey with water in its solid, liquid, and gaseous forms as it travels around the world.

Objectives

Students will:

- identify changes in states of water that enable water to move through the water cycle.
- describe the water cycle.

Materials

- *Audio recordings of water sounds* (water lapping on the shore of a pond, a storm, ocean waves, streams, a waterfall) (optional)
- *Copy of* ***Water Cycle Journey*** (script)

Making Connections

Students usually learn about the processes in the water cycle through indirect approaches such as diagrams and experiments. Using their imaginations, students discover what happens to water as it moves above, over, and under Earth's surface.

Background

Water can be found almost everywhere at any given time. As it changes forms, it travels throughout the world in the water cycle.

If you were able to travel with a water molecule, you would explore ocean depths, float through the atmosphere, splash down on a prairie, and weave among soil particles deep underground. How does water travel to all these places?

The processes that drive the water cycle are evaporation, condensation, transpiration, and precipitation. They are powered by solar energy and gravity. Causing water vapor to rise into the atmosphere, solar energy evaporates water from soil, plants, oceans, lakes, and streams. When it condenses in the atmosphere as rain, snow, hail, or sleet, gravity pulls it down again.

Because of the nature of water movement, a water molecule may be used over and over again throughout the centuries. The water you drink today could have dribbled down the back of a dinosaur, been locked in a glacier during the last ice age, spent 30,000 years in the ocean depths, or floated in a cloud over ancient Egypt!

Procedure

▼ *Warm Up*

Ask students to diagram or write a description of the water cycle and describe the processes that occur as water moves from one location to another.

▼ *The Activity*

1. **Ask students what it would be like to travel with water as it moves through the water cycle.**

2. **Tell students that you are going to take them on a journey through the water cycle with their imaginations. They should sit quietly and may wish to close their eyes.** You will be relating ideas and events and they should create pictures in their minds.

3. **Begin the tape of water sounds and start reading the script, *Water Cycle Journey*. Keep your voice even, level, and clear. Pause 2–3 seconds when you encounter the symbol "....." to let students imagine what you are describing.**

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Wrap Up

After the reading, ask students for their impressions. Have students list the major parts of the journey. Where did they go and how did they get there? Have each student diagram or write a description of the water cycle and relate events in the exercise to the diagram/description.

Instruct students to look for and record water movements that occur in the water cycle in their everyday lives (rain, evaporating puddles, a cloud, an animal drinking water). Have students keep track of relative humidity reports to remind them that even when they can't see water, it is moving in the air around them. Keep a class record of these events and reports. Have students create their own water journeys. An alternative is for students to create a comic strip of a water molecule traveling through the water cycle.

Assessment

Have students:

- identify the states of water as it moves through the water cycle (*Warm Up* and *Wrap Up*).
- describe the places water goes as it moves through the water cycle (*Wrap Up*).
- describe the processes that enable water to move (*Wrap Up*).

Extensions

Have students write a script for other parts of the water cycle. What happens when ground water is absorbed by a plant, when water from a stream is drunk by an animal, or, when river water is used for industrial or municipal purposes?

Students can create drawings, poems, or other artwork to reflect their perceptions of the water cycle.

Resources

Alexander, Gretchen. 1989. *Water Cycle Teacher's Guide*. Hudson, N.H.: Delta Education, Inc.

Ewing, Margaret S., and Terence J. Mills. 1994. "Water Literacy in College Freshmen: Could a Cognitive Imagery Strategy Improve Understanding?" *Journal of Environmental Education* (25) 4: 36-40.

Mayes, Susan. 1989. *What Makes It Rain?* London, England: Usborne Publications.

Schmid, Eleonore. 1990. *The Water's Journey*. New York, N.Y.: North-South Books.

Audio recordings of water sounds:

Alpine Stream. 1994. North Sound, North Word Press Inc.

Ocean Encounter. 1994. North Sound, North Word Press Inc.

Solitude Series. Contact: The Moss Music Group Inc., 48 West 38th Street, New York, NY 10018.

Water Cycle Journey

THE POOL

It is a beautiful summer day.....the sky is blue.....white puffy clouds float overhead .....the sun is shining.....the ground is warm.....a songbird sings in a nearby tree .....Imagine a still pool of water.....it is surrounded by soft green grass and tall trees ..... you are a water molecule in the pond .....moving gently back and forth..... you can feel other water molecules around you ..... you are all gently moving against each other .....touching.....close.....a gentle wind ripples the surface.....tiny waves move along .....you are bounced into each other..... you are all rocking back and forth .....the sun warms the surface of the water .....you are close to the surface.....now you are right at the surface.....you begin to move more rapidly .....the warmth and energy of the sun continue to strike you.....you become more energized and move more quickly.....suddenly you burst from the surface.....you are released into the air.....you have moved away from the others and you gently float alone.....invisible to the human eye.....apart from any other water molecules.

THE ATMOSPHERE

You float in the air and rise slowly.....there is great space around you.....you can see the pond below.....it grows more distant..... you continue to rise.....around you, you can see other water molecules.....but they are on their own.....you cannot reach out and touch them.....they, like you, continue to float and rise into the atmosphere..... as you rise, it is getting cooler.....your movement becomes slower.....a tiny particle floats by you ..... you grab on to it.....another water molecule grabs on to the same particle..... then another and another..... you all begin to bond to each other making the particle larger and larger..... you see other particles with water molecules attached..... everything around you begins to form patterns..... the patterns are like giant diamonds.....light passes through these ice crystals and creates prisms and tiny rainbows .....more and more water molecules come together.....you feel them surround you ..... you are becoming heavier..... heavier ..... heavier..... you begin to fall.....

THE SNOW

You are falling faster.....faster..... wind blows you up and around..... you swirl about..... trees appear.....then a white blanket below.....gravity takes you to the blanket..... you land on the surface..... above you and around you other particles fall ..... you become part of the white blanket .....everything becomes quiet and cold..... all around you stillness settles in.....

THE BIG MELT

Gently, ever so slowly..... a soft light begins to appear around you..... a gradual brightness ..... the light brings warmth with it..... you begin to move ever so slowly..... as the light brightens the warmth increases ..... you move back and forth..... around you water molecules begin to slip away..... they seem to move downward, sliding along..... you and surrounding water molecules are suddenly released and begin to slide.....

DOWN THE MOUNTAIN

As you tumble downward, you feel other water molecules push together around you..... suddenly you burst to the surface..... the sun is bright.....the air is fresh and dry.....it invigorates you..... all around you there are water molecules ..... traveling quickly..... all moving down a hill..... more groups of molecules join you..... more..... and more..... all traveling down quickly..... as you travel you see trees, grasses..... you come upon a large tree.....you bump against the roots and slow down.....

INTO THE GROUND

Gravity begins to pull at you.....you seep into the ground, weaving among sand and soil particles.....flowing underground is like moving, slow motion, through a dark obstacle course.....you are now deep underground, surrounded by soil particles.....suddenly, your movement seems to be more horizontal, the pressure of other molecules behind you pushes you along.....it appears lighter up ahead.....you and surrounding molecules spring out of the ground..... tumbling over ground, you continue your gradual descent to the foot of the mountain.....

BIG RIVER

Gradually you slow down..... you sense a gradual decrease in the slope of the land..... you now move gracefully in a large mass of water..... other streams contribute to your journey..... more and more water molecules collect together .....this is the big river..... along you travel..... other particles swirl around you..... you and other molecules work together to carry the particles.....you move more slowly now.....the slope is slight..... the slower you go the less energy you have to carry the particles ..... the particles slip from your grasp and sink but you move on.....

THE GIANT POOL

Ever so slowly the water moves toward the open..... grassy banks give way to cement canals..... all around you civilization makes itself known..... cars..... people ..... even an airport..... the sounds are loud and constant..... eventually you feel a change .....all around you are new materials ..... molecules of other substances.....they are strongly attracted to you..... these are the salts.....they fill in the gaps between you and other water molecules..... you and other particles continue to move about.....

WHAT NEXT?

There are many options open to you..... where will you go?..... the sun's energy may invigorate you, you could break away and float into the sky again .....other water molecules may hold on to you, you could swirl around the surface..... gravity may pull at you, you could explore the darkness of the deep..... a fish swims by, now there's a possibility..... imagine where you will go next..... picture it in your mind..... when you know where you are or will go, when you are ready, open your eyes.....

The Incredible Journey

Grade Level:
Upper Elementary, Middle School

Subject Areas:
Earth Science

Duration:
Preparation time: 50 minutes

Activity time: two 50-minute periods

Setting:
A large room or playing field

Skills:
Organizing (mapping); Analyzing (identifying components and relationships); Interpreting (describing)

Charting the Course
Other water cycle activities include "Water Models" and "Imagine!" In-depth investigations of how water moves can supplement this activity: condensing and evaporating ("Water Models"), filtering through soil ("Get the Ground Water Picture"), traveling over Earth's surface ("Branching Out!"), and moving through the atmosphere ("Piece It Together").

Vocabulary
condensation, evaporation, electromagnetic forces

Where will the water you drink this morning be tomorrow?

Summary

With a roll of the die, students simulate the movement of water within the water cycle.

Objectives

Students will:

- describe the movement of water within the water cycle.
- identify the states of water as it moves through the water cycle.

Materials

- *9 large pieces of paper*
- *Copies of* ***Water Cycle Table*** (optional)
- *Marking pens*
- *9 boxes, about 6 inches (15 cm) on a side*
  Boxes are used to make dice for the game. Gift boxes used for coffee mugs are a good size or inquire at your local mailing outlet. There will be one die [or box] per station of the water cycle. [To increase the pace of the game, use more boxes at each station, especially at the clouds and ocean stations.]
  The labels for the sides of the die are located in the *Water Cycle Table*. These labels represent the options for pathways that water can follow. Explanations for the labels are provided. For younger students, use pictures. Another option is to use a spinner—see the activity "A Drop in the Bucket" for spinner design. It is necessary to design a spinner for each station.
- *A bell, whistle, buzzer, or some sound maker*

Making Connections

When children think of the water cycle, they often imagine a circle of water, flowing from a stream to an ocean, evaporating to the clouds, raining down on a mountaintop, and flowing back into a stream. Role-playing a water molecule helps students to conceptualize the water cycle as more than a predictable two-dimensional path.

Background

While water does circulate from one point or state to another in the water cycle, the paths it can take are variable.

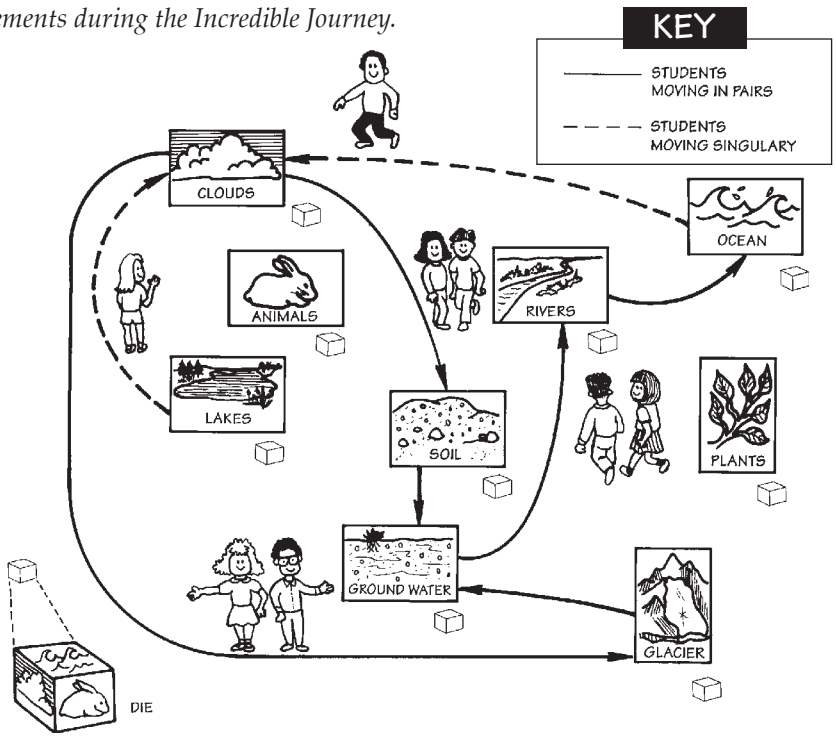
Heat energy directly influences the rate of motion of water molecules (refer to the activity "Molecules in Motion"). When the motion of the molecule increases because of an increase in heat energy, water will change from solid to liquid to gas. With each change in state, physical movement from one location to another usually follows. Glaciers melt to pools which overflow to streams, where water may evaporate into the atmosphere.

Gravity further influences the ability of water to travel over, under, and above Earth's surface. Water as a solid, liquid, or gas has mass and is subject to gravitational force. Snow on mountaintops melts and descends through watersheds to the oceans of the world.

One of the most visible states in which water moves is the liquid form. Water is seen flowing in streams and rivers and tumbling in ocean waves. Water travels slowly underground, seeping and filtering through particles of soil and pores within rocks.

Although unseen, water's most dramatic movements take place during its gaseous phase. Water is constantly evaporating, changing from a liquid to a gas. As a vapor, it can travel through the atmosphere over Earth's surface. In fact, water vapor surrounds us all the time. Where it condenses and returns to Earth depends upon loss of heat energy, gravity, and the structure of Earth's surface.

Using station illustrations, create a one page graphic on which students record their movements during the Incredible Journey.



Water condensation can be seen as dew on plants or water droplets on the outside of a glass of cold water. In clouds, water molecules collect on tiny dust particles. Eventually, the water droplets become too heavy and gravity pulls the water to Earth.

Living organisms also help move water. Humans and other animals carry water within their bodies, transporting it from one location to another. Water is either directly consumed by animals or is removed from foods during digestion. Water is excreted as a liquid or leaves as a gas, usually through respiration. When water is present on the skin of an animal (for example, as perspiration), evaporation may occur.

The greatest movers of water among living organisms are plants. The roots of plants absorb water. Some of this water is used within the body of the plant, but most of it travels up through the plant to the leaf surface. When water reaches the leaves, it is exposed to the air and the sun's energy and is easily evaporated. This process is called transpiration.

All these processes work together to move water around, through, and over Earth.

Procedure

▼ *Warm Up*

Ask students to identify the different places water can go as it moves through and around Earth. Write their responses on the board.

▼ *The Activity*

1. **Tell students that they are going to become water molecules moving through the water cycle**.

2. **Categorize the places water can move through into nine stations: Clouds, Plants, Animals, Rivers, Oceans, Lakes, Ground Water, Soil, and Glaciers. Write these names on large pieces of paper and put them in locations around the room or yard. (Students may illustrate station labels.)**

3. **Assign an even number of students to each station. (The cloud station can have an uneven number.) Have students identify the different places water can go from their station in the water cycle. Discuss the conditions that cause the water to move**. Explain that water movement depends on energy from the sun, electromagnetic energy, and gravity. Sometimes water will not go anywhere. After students have come up with lists, have each group share their work. The die for each station can be handed to that group and they can check to see if they covered all the places water can go. The *Water Cycle Table* provides an explanation of water movements from each station.

4. **Students should discuss the form in which water moves from one location to another**. Most of the movement from one station to another will take place when water is in its liquid form. However, any time water moves to the clouds, it is in the form of water vapor, with molecules moving rapidly and apart from each other.

5. **Tell students they will be demonstrating water's movement from one location to another**. When they move as liquid water, they will move in pairs, representing many water molecules together in a water drop. When they move to the clouds (evaporate), they will separate from their partners and move alone as individual water molecules. When water rains from the clouds (condenses), the students will grab a partner and move to the next location.

6. **In this game, a roll of the die determines where water will go**. Students line up behind the die at their station. (At the cloud station

they will line up in single file; at the rest of the stations they should line up in pairs.) Students roll the die and go to the location indicated by the label facing up. If they roll **stay**, they move to the back of the line.

When students arrive at the next station, they get in line. When they reach the front of the line, they roll the die and move to the next station (or proceed to the back of the line if they roll *stay*).

In the clouds, students roll the die individually, but if they leave the clouds they grab a partner (the person immediately behind them) and move to the next station; the partner does not roll the die.

7. **Students should keep track of their movements**. This can be done by having them keep a journal or notepad to record each move they make, including stays. Students may record their journeys by leaving behind personalized stickers at each station. Another approach has half the class play the game while the other half watches. Onlookers can be assigned to track the movements of their classmates. In the next round the onlookers will play the game, and the other half of the class can record their movements.

8. **Tell students the game will begin and end with the sound of a bell (or buzzer or whistle). Begin the game!**

▼ *Wrap Up and Action*

Have students use their travel records to write stories about the places water has been. They should include a description of what conditions were necessary for water to move to each location and the state water was in as it moved. Discuss any *cycling* that took place (that is, if any students returned to the same station).

Provide students with a location (e.g., parking lot, stream, glacier, or one from the human body—bladder) and have them identify ways water can move to and from that site. Have them identify the states of the water.

Have older students teach "The Incredible Journey" to younger students.

Assessment

Have students:

- role-play water as it moves through the water cycle (step 8).
- identify the states water is in while moving through the water cycle (step 4 and ***Wrap Up***).
- write a story describing the movement of water (***Wrap Up***).

Extensions

Have students compare the movement of water during different seasons and at different locations around the globe. They can adapt the game (change the faces of the die, add alternative stations, etc.) to represent these different conditions or locations.

Have students investigate how water becomes polluted and is cleaned as it moves through the water cycle. For instance, it might pick up contaminants as it travels through the soil, which are then left behind as water evaporates at the surface. Challenge students to adapt "The Incredible Journey" to include these processes. For example, rolled-up pieces of masking tape can represent pollutants and be stuck to students as they travel to the soil station. Some materials will be filtered out as the water moves to the lake. Show this by having students rub their arms to slough off some tape. If they roll *clouds*, they remove all the tape; when water evaporates it leaves pollutants behind.

Resources

Alexander, Gretchen. 1989. *Water Cycle Teacher's Guide*. Hudson, N.H.: Delta Education, Inc.

Mayes, Susan. 1989. *What Makes It Rain?* London, England: Usborne Publications.

Schmid, Eleonore. 1990. *The Water's Journey*. New York, N.Y.: North-South Books.

Where will this student go next on her incredible journey?

Water Cycle Table

STATION	DIE SIDE LABELS	EXPLANATION
Soil	one side *plant*	Water is absorbed by plant roots.
	one side *river*	The soil is saturated, so water runs off into a river.
	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	two sides *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	one side *stay*	Water remains on the surface (perhaps in a puddle, or adhering to a soil particle).
Plant	four sides *clouds*	Water leaves the plant through the process of transpiration.
	two sides *stay*	Water is used by the plant and stays in the cells.
River	one side *lake*	Water flows into a lake.
	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	one side *ocean*	Water flows into the ocean.
	one side *animal*	An animal drinks water.
	one side *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	one side *stay*	Water remains in the current of the river.
Clouds	one side *soil*	Water condenses and falls on soil.
	one side *glacier*	Water condenses and falls as snow onto a glacier.
	one side *lake*	Water condenses and falls into a lake.
	two sides *ocean*	Water condenses and falls into the ocean.
	one side *stay*	Water remains as a water droplet clinging to a dust particle.

Water Cycle Table, continued

STATION	DIE SIDE LABELS	EXPLANATION
Ocean	two sides *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	four sides *stay*	Water remains in the ocean.
Lake	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	one side *animal*	An animal drinks water.
	one side *river*	Water flows into a river.
	one side *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	two sides *stay*	Water remains within the lake or estuary.
Animal	two sides *soil*	Water is excreted through feces and urine.
	three sides *clouds*	Water is respired or evaporated from the body.
	one side *stay*	Water is incorporated into the body.
Ground Water	one side *river*	Water filters into a river.
	two sides *lake*	Water filters into a lake.
	three sides *stay*	Water stays underground.
Glacier	one side *ground water*	Ice melts and water filters into the ground.
	one side *clouds*	Ice evaporates and water goes to the clouds (sublimation).
	one side *river*	Ice melts and water flows into a river.
	three sides *stay*	Ice stays frozen in the glacier.

Soil

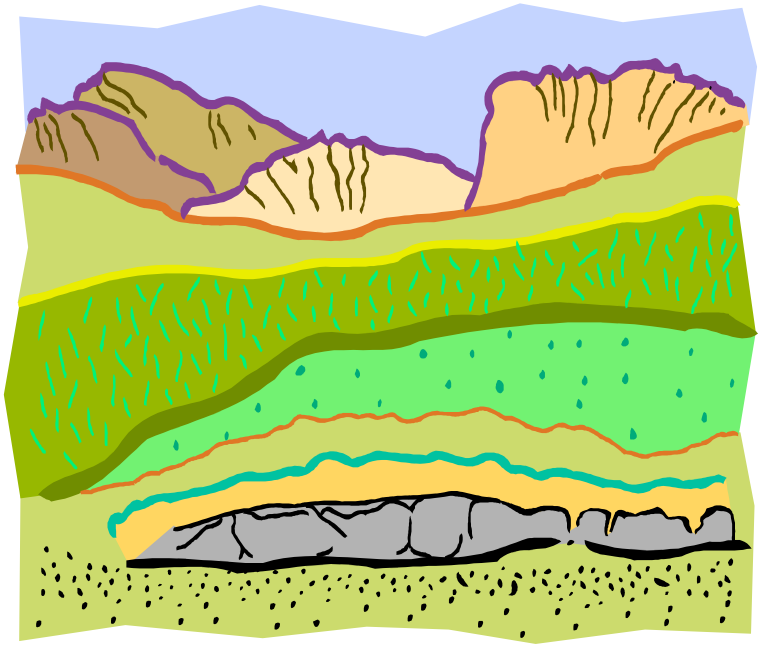
Plants

River

Lake

Clouds

Ocean



Ground Water

Glacier

Project WET Activity Extension

Bead Extension to: *Incredible Journey (Project WET, p.161) & Blue Traveler (Conserve Water, p.43)*

Option 1:

Have students create a water cycle bracelet. As students move through the water cycle, ask them to label their journey maps in the order in which they move from station to station. For example, if they roll the die and rain into the "ocean," have students record #1 by the ocean; #2 by the second station they roll, and so forth. After they have played the game and disclosed their conclusions about the water cycle, have them create a water cycle bracelet. Make available lengths of twine on which beads may be strung. Purchase beads in nine different colors: brown for ground water, blue for the ocean, white for the glacier, and so forth. Using their maps, students will string the appropriate colored beads on their bracelets relative to the order of stations they visited. Have students wear the bracelets and, as they point to each bead, tell the story of the water molecule as it moves through the water cycle.

~Sue McWilliams, Project WET Oregon Coordinator

Option 2:

Assign each station a different pony bead color (pony beads work the best as they have larger openings for stringing.) Instead of having students write down the stations they visit on their journey, they just take beads from each station and string them on leather, twine, or elasticized string. The bracelet records their journey. This works well with younger kids who can't write yet or at field days when many kids go through the activity and may not have writing materials along. Beads may be strung into a bracelet, ankle bracelet, necklace or even into a dream catcher.

Blue Traveler:

When playing this newer version of The Incredible Journey, the addition of opaque or transparent beads for the constructed parts of the water cycle allows you to make some connections with your students following the activity.

> *"When I use the Blue Traveler activity I used transparent beads for the constructed cycle. So, when you do the activity you can have everyone look at their bracelets and see very quickly how many times humans interact with - and impact - the water cycle."*
>
> ~Nancy Brown ~ Elkhart County SWCD ~ Indiana

A supply source for beads that I have used is Bolek's Crafts in Ohio. Currently their beads are $3.00 per 1000 beads and you can order almost any color. They also carry leather and other twine suitable for stringing the beads (yarn frays too quickly.)

Bolek's Craft Supply Inc.
330 N. Tuscarawas Ave
Dover, Ohio 44622-04665
Phone: **800-743-2723**
Fax: 800-649-3735
http://www.bolekscrafts.com/

Be sure to check the National Project WET home page for additional extensions and ideas on activities: http://www.projectwetusa.org. In Minnesota, contact: April Rust ~ MN Project WET ~ 651-259-5706 ~ april.rust@dnr.state.mn.us ~ http://www.dnr.state.mn.us/projectwet

Adapted from Indiana Project WET – 4/2001

Big River Journey Classroom Activity: Geology

Create Sedimentary Strata

Objective: The student will utilize two types of sediment and water to create sedimentary layers as found in sedimentary rocks along the Mississippi River.

Concept: Moving water carries and sorts sediment, changes landforms, and creates strata.

Grade level/ time req't: 4-6; 20 minutes initial activity, plus at least one day to observe

Materials:
sand
dried powdered clay (available from art or pottery supply stores, e.g. "Continental Clay")
water
pint-sized jar (clear plastic or glass) with lid (students may bring in own jars in advance)
measuring cups (to measure 1/4 C. and 1 C.)

Introduction: Show students a picture of the Grand Canyon. Ask students for ideas about how the layers (strata) might have been created. Tell them that similar layers can be seen along the Mississippi River between Minneapolis and St. Paul. This experiment can provide clues to how the strata were formed. Tell students that they are geologists.

Procedure:
1) Each student group (4 students) should place in their jar: 1/4 cup sand and 1/4 cup dry clay powder. Use dust mask. Close lid and shake jar so no layers are evident.
2) Predict what will happen after water is added and the jar is shaken. Write the prediction.
3) Add 1 cup water. Close lid and shake jar again to mix contents.
4) Set aside. *Do not disturb* jar.
5) Observe contents after 1 min., 15 min., 30 min., 1 hour, 1 day. Record observations.
6) Discuss results and draw conclusions. (Why did the sand and clay form layers? Which layer is on top? Why?)

Conclusions and follow-up: Given the results of the experiment, how do you think the strata of sedimentary rocks along the Mississippi River might have been formed? Are layers on the top formed before or after those under them?

Background for teacher: The ground in the Twin Cities is composed mainly of sedimentary rock layers (strata). These strata are exposed in many places along the Mississippi River.

Sediment is particles of soil such as sand, silt, or clay that can be suspended (carried) in water; sedimentary *strata* are layers of sediment compressed over time.

Moving water can carry and sort sediment. How much sediment it can carry depends on the amount of movement (energy) in the water. When water movement slows, larger, heavier particles of suspended sediment (e.g. sand) will settle out first; when the movement slows more or stops, finer sediments (such as clay particles) will also settle.

Sedimentary strata visible along the Mississippi River resulted from the rising and falling of tropical seas that covered Minnesota during the Ordovician period, from 500 million to 435 million years ago. These sedimentary deposits were hardened into rocks as a result of time and pressure. Sandstone deposits are evidence of sand beaches; shale (composed of fine clay particles) formed during a period of deeper, calmer seas. Geologists read sedimentary strata much as biologists read tree rings. The most recent strata are normally on top.

The geology of the Mississippi River set the stage for the Twin Cities by causing large river-boats to have to stop in St. Paul, and by creating waterpower opportunities at St. Anthony Falls.

Big River Journey Classroom Activity: Geology

Make Your Own Fossil

Objective: The student will create an imitation fossil that employs at least two elements of the definition of what a fossil is.

Grade level/ time req't: 4-6; 30 minutes

Materials:
moist workable clay (any natural clay of type used by potters)
miscellaneous small bits of plant and animal material (e.g., leaves, stems, seeds, feathers, pieces of snail or shell, etc. – *These may be collected by students in advance.)*
sample fossil from a local Mississippi River bluff (very helpful, but not essential)
wash basin and towels (for washing hands after creating "fossil")

Introduction:
Ask students for ideas of how to find out about the origins of the Mississippi River and its surrounding landscape before people were here. Explain that rocks and fossils tell such a story of earth's history. Show a sample fossil from rock found along the Mississippi River. Ask a student to describe what she sees in the sample. *Define a **fossil** as any trace or remnant of a life form (plant or animal) from a past geological age, embedded in rock.* Explain that a fossil can be 1) a piece of the original plant or animal itself, or 2) an imprint of the plant or animal (e.g., a leafprint or footprint in solidified mud), or 3) a mineralized replacement of the animal or plant that takes its form.

Procedure:
1) Each student should get a lump of moist clay about the size of the palm of their hand. Work clay into flat "rock" form.
2) Whether previously collected by students or supplied by teacher, students should have a few very small pieces of plant (and optionally, clean animal remnants such as snail, shell or feather) to work into clay.
3) Each student must choose two of the following possible fossil types to show in their clay "rock." Choices must be clearly evident in final product.
- embedded plant material
- imprint of plant (e.g. leaf print or stem print)
- embedded animal remnant or evidence (e.g. snail or shell bit; …or Barbie shoe!)
- imprint of animal remnant or evidence (e.g. feather print, or human hand print)

4) Set aside to dry. The clay will harden into a hard "fossil."

Evaluation: Identify two types of "fossils" in final product.

Background for teacher: Fossils of sea life found may be found in sedimentary rock strata (limestone and shale) along the Mississippi River. These fossils tell us that tropical seas advanced and receded over Minnesota during the Ordovician period of the Paleozoic Era, approximately 500-435 million years ago.

River Geology Vocabulary

Basic Vocabulary:

geology - the study of the origin and history of the earth; the study of rocks

fossil - any trace or remnant of a life form from a past geological age, embedded in rocks

strata - layers of rock

erosion - breakdown or weathering of rocks, sediment or soil by wind, water, etc.

Ice Age - common name for time period during which glaciers were abundant

glacier - a large mass of slowly moving ice

Intermediate Vocabulary:

geological era - a basic division of geological time, composed of one or more periods

geological period - a portion of a geological era

geological epoch - a portion of a geological period

sedimentary - a classification of rocks created by deposits of sediment (particles of silt, sand, clay, etc.)

sandstone - a sedimentary rock composed chiefly of sandlike grains of quartz

shale - a fine-grained, layered sedimentary rock formed from clay, silt or mud; often gray

limestone - a sedimentary rock composed of calcium carbonate, often from shell fragments

Advanced Vocabulary:

Paleozoic era - a geological time from 570 million to 225 million years ago during which early forms of life appeared

Ordovician period - part of the Paleozoic era from 500 million to 430 million years ago, characterized by small sea-dwelling organisms (found in Mississippi River valley fossils)

Pleistocene epoch - ice age time period, 2 million to 10,000 years ago. (The Upper Mississippi River took its present route at the end of this time period.)

River Geology Extensions

Pre-trip activity ideas:

- **Science/math.** Create a timeline of geological eras and periods, and make corresponding descriptions of plant and animal life associated with each.

- **Art/science.** Find pictures of various eras and periods. Create your own picture of a specific geological period. Use the class's pictures to illustrate a geological timeline.

- **Science.** Classify rocks as belonging to one of three broad categories – igneous, sedimentary, or metamorphic – and learn the meaning of each. Identify examples of each type.

- **Writing.** Compose a story correctly using at least half of your vocabulary words.

- **Reading.** Read "Minnesota's Rocky Roots" (for young naturalists) about Minnesota geology in The Minnesota Volunteer, Sept.-Oct., 1995. Teacher guide and article: *www.dnr.state.mn.us/young_naturalists/rockyroots/index.html*

- **Career exploration.** Find out what a geologist does. Imagine that you are a geologist, and write about your work.

Post-trip activity ideas:

- **Art.** Draw and color the river gorge showing a rock outcrop. Make a display showing what you've learned about Mississippi River geology. Make a drawing of fossils seen. Or, use fossil patterns to create a larger abstract design.

- **Writing.** Write a poem or short story about your life as a brachiopod in the Ordovician sea that once covered Minnesota, or as a time traveler atop an ice age glacier melting to start the Mississippi River. Describe your surroundings.

- **Social studies.** Find out how people have utilized the geology of the river and river valley. What uses have been found for limestone, shale and sandstone in building, agriculture, gardening, food production and medicine?
  [Teacher note: these rocks are used as building materials and can be seen in buildings of St. Paul (though local sandstone is too soft for use in building.) Shale deposits have been used for brick-making; lime from limestone is used to make cement, to lower the pH of soils, and as an antacid; caves have been carved out of sandstone for growing mushrooms, sand from sandstone has been used for making glass. Gravel from river islands is widely used in construction.]

- **Science field study.** Explore for fossils in the Lilydale "brickyards" or other site along the Mississippi River. Permit/info: http://www.stpaul.gov/index.aspx?NID=1560

- **Science.** Find out more about fossils. What kind of life is associated with each of the fossils you found?

- **Speaking.** Teach others what you have learned about the geology of the river.

Science Museum of Minnesota

Big River Journey Classroom Activity: Aquatic Invertebrates

Aquatic Bugs & Their Feeding Habits

Materials - for a group of 8 students:

copies of aquatic insects handout (key) for students 2
staple removers
1 small suction cup
2 tweezers
2 tea strainers
1 straw
large plastic tub filled with 4-6 gallons of water (sample wetland)
chopped up Jell-0
small pieces of sponges (submerged & floating)
small rocks
bread or cookie pieces (to be soaked in water)
twigs

Procedure

1. Fill the tub with water and small pieces of gelatin (Jell-0), scatter the small pieces of sponge, cookie or bread pieces, rocks and twigs throughout the tub. Hand out the mouth parts (staple remover, suction cups, etc.) and have the students discover which food their "mouth" will catch. After 30 seconds (or so) have the students switch "mouths." Discuss which mouths caught what food. How did the students decide which food their mouths would catch? Did some mouths catch more food? Why?

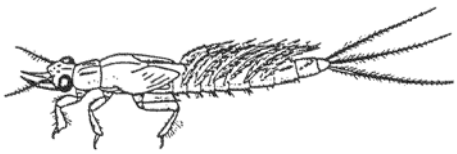
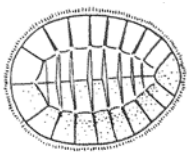
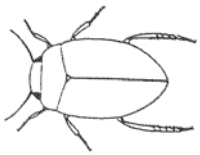
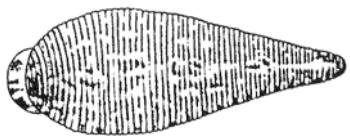
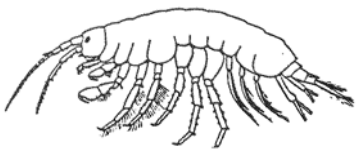
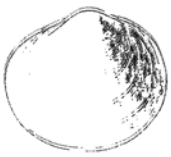
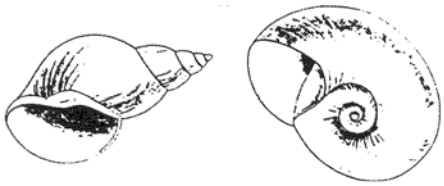
2. Hand out the aquatic insect sheet and try to determine what each insect eats by examining its mouthparts. How are the insect mouths similar to the tools the students used in the activity? Ask the students to match up the identified insects to the "mouthparts" they used earlier. Can they tell which animal feeds on what? How can they tell?

Based on the above information determine the aquatic food chain. There are aquatic insects that: graze on vegetation, are filter feeders (filter the water for food), eat other animals, are parasitic, and are decomposers.

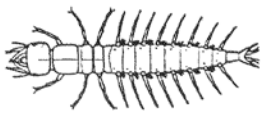
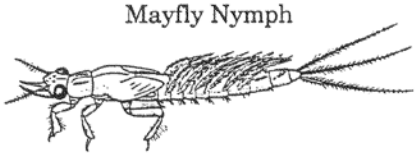
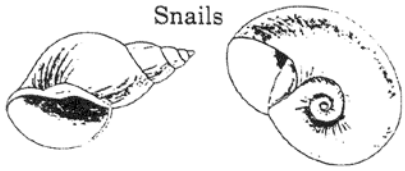
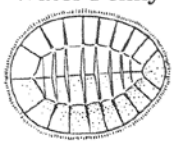
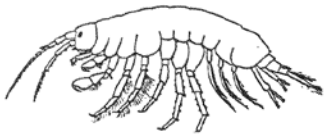
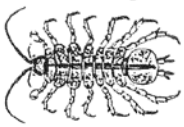
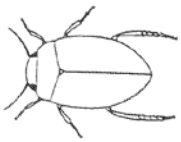
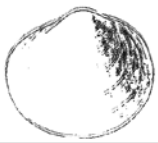
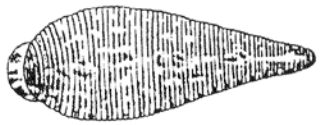
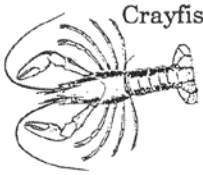
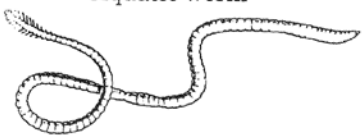
Background

Aquatic insects have job specific mouths and mouthparts. Just as birds beaks are specialized, so are the mouths of aquatic insects, the various "tools" the students used were symbolic of aquatic mouthparts - leeches have suction mouths (for sucking the body fluids of their prey), snails have scraping mouths (for scraping the algae off of rocks, etc.), dragonfly larvae have large chewing mouthparts covered by a scoop like lip (feeding on insects larvae, worms, etc.), and flies have piercing - sucking mouthparts. Aquatic insects can be identified by their mouthparts, along with other characteristics (such as number of wings', number of legs or tail appendages). Aquatic insects are related to terrestrial (land) insects in many ways. Many of them go through the various life stages and finally metamorphose into an adult. Just as a butterfly starts as a caterpillar, the dragonfly starts much the same way - except that the dragonfly can live up to three years in its larval (or nymph) phase before it finally turns into an adult dragonfly.

Characteristics of Aquatic Invertebrates

Stonefly Nymph	-two “tails” -two hooks on end of each leg -chewing mouthparts	
Mayfly Nymph	-usually have “three” tails sometimes only two -only one hook at end of each leg -chewing mouthparts	
Dragonfly Nymph	-two pair of wings -chewing mouthparts modified with A prehensile lower lip	
Water Penny	-brown, very flat body -mandibles (herbivore)	
Riffle Beetle	-small black beetle that swims underwater -chewing mouthparts	
Leech	-segmented worms -anterior and posterior suckers	
Scud	-looks like a small white shrimp -flat from side to side -feeds on plant and decaying matter	
Clams or Mussels	-shell has two parts -filter feeder	
Snails	-single coiled shell -rasping tongue (radula)	

Classification of Invertebrates

CLASS I Sensitive	CLASS II Somewhat Sensitive	CLASS III Not Sensitive
Stonefly Nymph 	Beetle Larvae 	Midge Larvae 
Mayfly Nymph 	Cranefly Larvae 	Snails 
Water Penny 	Scud 	Sowbug 
Riffle Beetle 	Clam or Mussels 	Leech 
Caddisfly Larvae 	Crayfish 	Aquatic worm 
	Dragonfly Nymph 	
	Damselfly Nymph 	
	Blackfly Larvae 	

Macroinvertebrate Mayhem

Grade Level:
Upper Elementary, Middle School

Subject Areas:
Ecology, Environmental Science, Mathematics

Duration:
Preparation time:
Part I: 20 minutes
Part II: 50 minutes

Activity time:
Part I: 50 minutes
Part II: 50 minutes

Setting:
Large playing field

Skills:
Gathering information (researching); Organizing (categorizing); Interpreting (relating, drawing conclusions)

Charting the Course
Orient students to stream ecology prior to this activity. The Extension of "Stream Sense" provides a variety of streamside investigations. Students can learn how nonpoint source pollutants accumulate in a stream in "Sum of the Parts." Treating polluted water is addressed in "Sparkling Water" and "Reaching Your Limits."

Vocabulary
macroinvertebrate, biodiversity

How does the phrase "appearances can be deceiving" apply to the water quality of a sparkling, crystal-blue stream?

Summary

Students play a game of tag to simulate the effects of environmental stressors on macroinvertebrate populations.

Objectives

Students will:

- illustrate how tolerance to water quality conditions varies among macroinvertebrate organisms.
- explain how population diversity provides insight into the health of an ecosystem.

Materials

- *Samples of macroinvertebrate organisms* (optional)
- *Resources* (texts, field guides, encyclopedia)
- ***Identification labels** for macroinvertebrate groups, one per student* (Divide the number of students by 7 and make that number of copies of each macroinvertebrate picture. One side of each label should have a picture of one of the seven macroinvertebrates. The other side of each label [except those for midge larvae and rat-tailed maggots] should have a picture of either the midge larva or rat-tailed maggot. For durability, the cards may be laminated. Use clothespins or paper clips to attach labels to students' clothing.)
- *Pillowcases or burlap bags*
- *Chart paper or a chalkboard*

NOTE: To adapt this activity for your area, call the state Department of Land and Natural Resources or Fish and Wildlife Service for information.

Making Connections

People may be able to assess the water quality of a stream by its appearance and smell. Sometimes, however, a polluted stream looks and smells clean. Students may have already learned certain ways to test water quality and may have conducted macroinvertebrate stream studies. Simulating how environmental stressors affect macroinvertebrate populations helps students relate the concept of biodiversity to the health of aquatic ecosystems.

Background

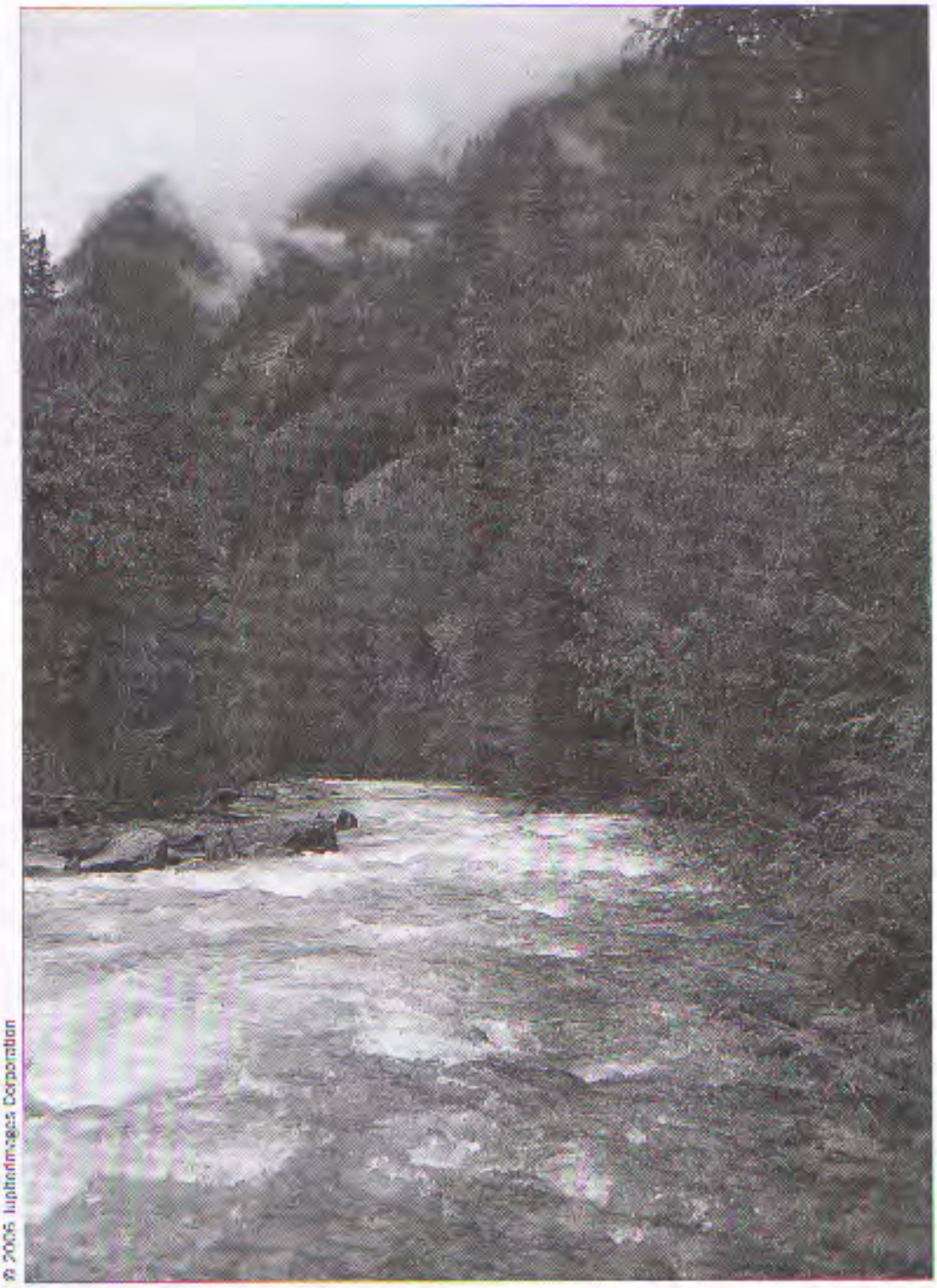
Macroinvertebrates (organisms that lack an internal skeleton and are large enough to be seen with the naked eye) are an integral part of wetland and stream ecosystems. Examples of macroinvertebrates include mayflies, stoneflies, dragonflies, rat-tailed maggots, scuds, snails, and leeches. These organisms may spend all or part of their lives in water; usually their immature phases (larvae and nymphs) are spent entirely in water. Larvae do not show wing buds and are usually very different in appearance from the adult versions of the insects. (Maggot is the term used for the larva of some flies.) Nymphs generally resemble adults, but have no developed wings and are usually smaller.

A variety of environmental stressors can impact macroinvertebrate populations. Urban and/or agricultural runoff can produce conditions that some macroinvertebrates cannot tolerate. Sewage and fertilizers added to streams induce the growth of algae and bacteria that consume oxygen and make it unavailable for macroinvertebrates. Changes in land use from natural vegetation to a construction site or to poorly protected cropland may add sediment to the water. Sedimentation destroys habitats by smothering the

rocky areas of the stream where macroinvertebrates live. The removal of trees along the banks of a river and alteration along the banks of a river and alteration of stream velocity can both alter normal water temperature patterns in the stream. Some organisms depend on certain temperature patterns to regulate changes in their life cycles. Other stressors include the introduction of alien species and stream channelization.

Some macroinvertebrates, such as the mayfly and stonefly nymphs and caddisfly larvae, are sensitive (intolerant) to changes in stream conditions brought about by pollutants. Some of these organisms will leave to find more favorable habitats, but others will be killed or will be unable to reproduce. Macroinvertebrates (e.g., rat-tailed maggots and midge larvae) that may thrive in polluted conditions are called tolerant organisms. Other organisms, called facultative organisms (e.g., dragonfly and damselfly nymphs) prefer good stream quality but can survive polluted conditions.

Water quality researchers often sample macroinvertebrate populations to monitor changes in stream conditions over time and to assess the cumulative effects of environmental stressors. Environmental degradation will likely decrease the diversity of a community by eliminating intolerant organisms and increasing the number of tolerant organisms. If the environmental stress is severe enough, species of intolerant macroinvertebrates may disappear altogether. For example, if a sample of macroinvertebrates in a stream consists of rat-tailed maggots, snails, and dragonfly nymphs, the water-quality conditions of that stream are probably poor (i.e., low oxygen level, increased sediment, contaminants). If, on the other hand, the sample contains a diversity of organisms, the stream conditions are likely good.



Unimpaired streams host a wide variety of aquatic macroinvertebrates.

However, baseline data is essential because some healthy streams may contain only a few macroinvertebrate species. A variety of food sources, adequate oxygen levels, and temperatures conducive to growth all characterize a healthy stream.

Procedure

▼ *Warm Up*

Review the conditions that are necessary for a healthy ecosystem. Ask students to describe what could happen to an ecosystem if these conditions were altered or eliminated. What clues would students look for to determine if an ecosystem was healthy or not?

Remind students that a stream is a type of ecosystem. Ask them how they would assess the health of a stream. Students may suggest conducting a visual survey of the surrounding area and answering the following questions: What land use practices are visible in the area? How might these practices affect the stream? Is there plant cover on the banks of the stream or are the banks eroded? What color is the water? What is living in the stream?

Identify several environmental stressors (e.g., urban and agricultural runoff, sedimentation, introduction of alien species) and discuss how they can affect the health of a stream. Review the many types of plants and animals, including insects, that live in streams. How might environmental stressors affect these organisms? Would all organisms be impacted in the same way? Why or why not?

▼ *The Activity*

Part I

1. **Introduce the practice of sampling macroinvertebrate populations to monitor stream quality.** Show students pictures or samples of macroinvertebrates used to monitor stream quality.

2. **Divide the class into seven groups and assign one macro-invertebrate (from *Macroinvertebrate Groups*) to each group. Have group members conduct library research to prepare a report for the class about their organism.** The report should include the conditions (e.g., clean water, abundant oxygen supplies, cool water) the organism must have to survive.

Macroinvertebrate Groups
Caddisfly larva
Mayfly nymph
Stonefly nymph
Dragonfly nymph
Damselfly nymph
Midge larva
Rat-tailed maggot

3. **Have students present their reports to the class and compare each organism's tolerance of different stream conditions.**

Part II

1. **Tell students they are going to play a game that simulates changes in a stream when an environmental stressor, such as a pollutant, is introduced. Show students the playing field and indicate the boundaries.**

2. **Have one student volunteer to be an environmental stressor (e.g., sedimentation, sewage, or fertilizer). Discuss the ways that a stream can become polluted and how this can alter stream conditions.** With a large class or playing field, more students will need to be stressors.

3. **Divide the rest of the class into seven groups to play the game. Each group represents one type of macroinvertebrate species listed in *Macroinvertebrate Groups*. Record the number of members in each group, using a table similar to A *Sample of Data From Macroinvertebrate Mayhem*.**

NOTE: Try to have at least four students in each group. For smaller classes, reduce the number of groups. For example, eliminate the stonefly nymph and the damselfly nymph groups.

Intolerant Macroinvertebrates and Hindrances

ORGANISM	HINDRANCE	RATIONAL FOR HINDRANCE
Caddisfly	Must place both feet in a "bag" and hop across field, stopping to gasp for breath every five hops.	Caddisflies are intolerant of low oxygen levels.
Stonefly	Must do a push-up every ten steps.	When oxygen levels drop, stoneflies undulate their abdomens to increase the flow of water over their bodies.
Mayfly	Must flap arms and spin in circles when crossing field.	Mayflies often increase oxygen absorption by moving gills.

*Caddisfly larvae build cases and attach themselves to rocks for protection and stabilization.

A Sample of Data From Macroinvertebrate Mayhem:

ORGANISM	TOLERANCE	NUMBERS (AT START AND AFTER EACH ROUND)			
		START	ROUND ONE	ROUND TWO	ROUND THREE
Caddisfly larva	Intolerant	5	2	2	2
Mayfly nymph	Intolerant	5	4	1	0
Stonefly nymph	Intolerant	4	4	4	2
Dragonfly nymph	Facultative	5	5	4	4
Damselfly nymph	Facultative	4	4	4	3
Midge larva	Tolerant	4	6	7	9
Rat-tailed maggot	Tolerant	4	6	9	11
TOTAL		31	31	31	31

4. **Distribute appropriate identification labels to all group members.** The picture of each group's macroinvertebrate should face outward when labels are attached.

5. **Inform students that some macroinvertebrates have hindrances to crossing the field.** (See *Intolerant Macroinvertebrates and Hindrances.*) These obstacles symbolize sensitive organisms' intolerance to pollutants. Have students practice their motions.

6. **Assemble the macroinvertebrate groups at one end of the playing field and the environmental stressor(s) at midfield. When a round starts, macroinvertebrates will move toward the opposite end of the field and the stressor will try to tag them. To "survive," the macroinvertebrates must reach the opposite end of the field without being tagged by the environmental stressor.** The environmental stressor can try to tag any of the macroinvertebrates, but will find it easier to catch those with hindered movements.

7. **Begin the first round of the game. Tagged macroinvertebrates must go to the sideline and flip their identification labels to display the more tolerant species (i.e., rat-tailed maggot or midge larva). Tagged players who are already in a tolerant species group do not flip their labels.**

8. **The round ends when all of the macroinvertebrates have either been tagged or have reached the opposite end of the playing field. Record the new number of members in each species.**

9. **Complete two more rounds, with all tagged players rejoining the macroinvertebrates who successfully survived the previous round. Record the number of members in each species of macroinvertebrates at the conclusion of each round.** Because some players will have flipped their identification labels, there will be a larger number of tolerant species in each successive round.

▼ *Wrap Up and Action*

The game is completed after three rounds. Discuss the outcome with students. Emphasize the changes in the distribution of organisms among groups. Have students compare population sizes of groups at the beginning and end of the game and provide reasons for the changes. Review why some organisms are more tolerant of poor environmental conditions than others. Have students compare the stream environment at the beginning of the game to the environment at the end.

Have students investigate a nearby stream. What types of macroinvertebrates live there? How would students describe the diversity of organisms? Do students' findings provide insight into the quality of the stream? What other observations can students make to determine stream quality? They may want to report their findings to local watershed managers or water quality inspectors.

Assessment

Have students:

- analyze a stream based on a visual assessment (***Warm Up***).
- describe macroinvertebrate organisms and identify what stream conditions they need to survive (***Part I***, steps 2 and 3, and ***Wrap Up***).
- explain how some organisms indicate stream quality (***Wrap Up***).
- interpret stream quality based on the diversity and types of organisms found there (***Wrap Up***).

Upon completing the activity, for further assessment have students:

- develop a matching game in which pictures of streams in varying conditions are matched with organisms that might live there.

Extensions

Supplement the students' macroinvertebrate survey of a stream with chemical tests and analyses. (See **Resources**.)

Have students design their own caddisfly case.

Have students study aspects of biodiversity by adding another round to the game. For example, add a fourth round in which all organisms are caddisflies. This round will demonstrate how a few intolerant species or a single species can be quickly eliminated.

Resources

Ancona, George. 1990. *River Keeper*. New York, N.Y.: Macmillan.

Cromwell, Mare. 1992. *Investigating Streams and Rivers*. Ann Arbor, Mich.: Global Rivers Environmental Education Network (GREEN).

Delta Labs. 1987. *Adopt-A-Stream Teacher's Handbook*. Rochester, N.Y.: Delta Laboratories, Inc.

Edelstein, Karen. 1993. *Pond and Stream Safari: A Guide to the Ecology of Aquatic Invertebrates*. Ithaca, N.Y.: Cornell University.

Ellet, K. K. 1988. *An Introduction to Water Quality Monitoring Using Volunteers*. Baltimore, Md.: Citizens for the Chesapeake Bay, Inc.

Mitchell, M. K., and W.B. Stapp. 1986. *Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools*. Dexter, Mich.: Thompson-Shore Printers.

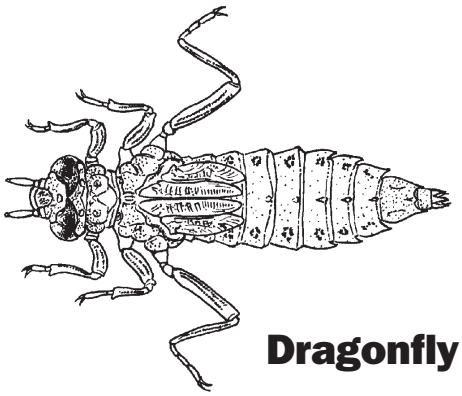
Project WILD. 1992. Activity "Water Canaries." From *Aquatic Project WILD*. Bethesda, Md.: Western Regional Environmental Education Council.

Save Our Streams. Contact: Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington, VA 22209.

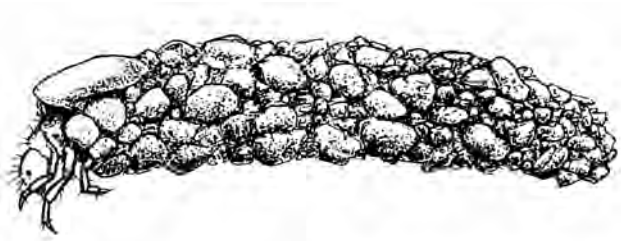
The Stream Scene: Watersheds, Wildlife and People. 1990. Portland, Oreg.: Oregon Department of Fish & Wildlife.

Students 'become' macroinvertebrates during "Macroinvertebrate Mayhem."

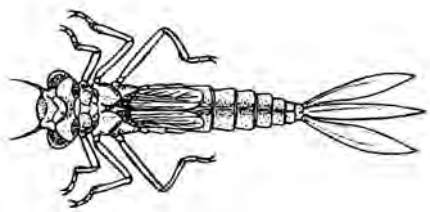
Identification Labels



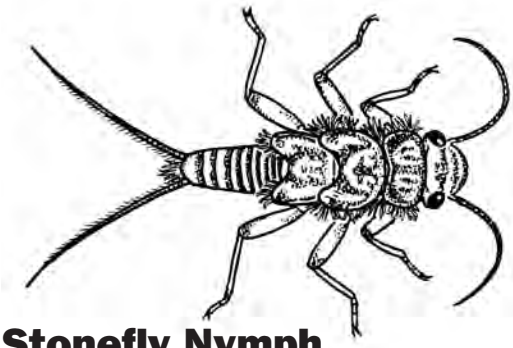
Dragonfly Nymph



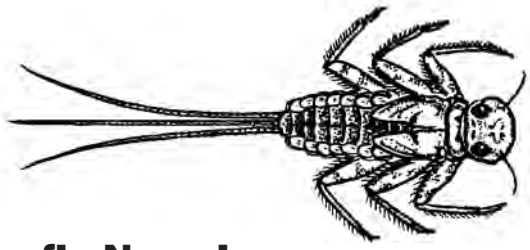
Caddisfly Larva



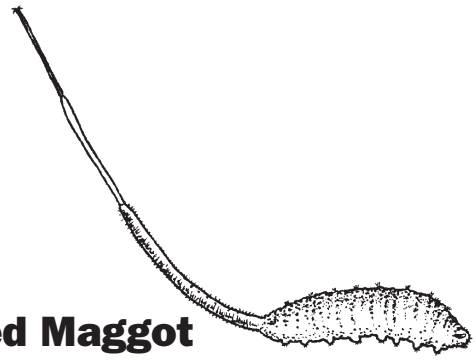
Damselfly Nymph



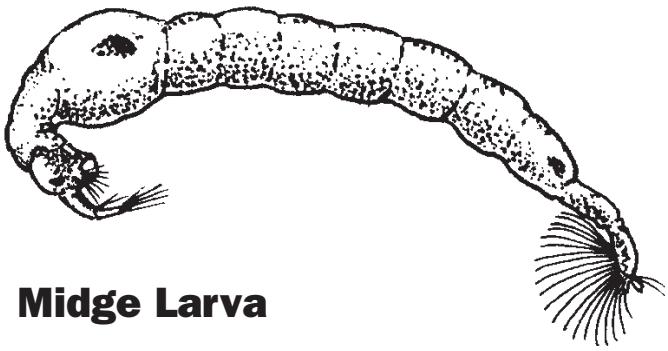
Stonefly Nymph



Mayfly Nymph



Rat-tailed Maggot



Midge Larva

Environmental Stressor

ILLUSTRATION OF MACROINVERTEBRATES USED WITH PERMISSION OF THE ARTIST, TAMARA SAYRE.

Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)

Shells

Single Shell

spiral, opening on left

Pouch Snail

spiral, opening on right

Gilled Snail

coiled

Orb Snail

conical

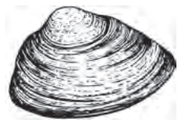
Limpet

Double Shell

small, whitish, tan or brown

Pill or Fingernail Clam

large, 2 to 8 inches, dark-colored



Freshwater Mussel

No Shells

Legs

With Tentacles, Brushes or "Tails"

long breathing tube

Rat tailed Maggot Larva

two fringed "tails"

Water Snipe Fly Larva

smooth, "stiff," small head

Horse Fly Larva

large, grey with tentacles

Crane Fly Larva

white or grey with tentacles

Crane Fly Larva

big "head," active

Midge Pupa

black, attaches to hard surfaces

Black Fly Larva

10+ Legs

lobster-like

Crayfish

shrimp-like, swims on side

Scud or Amphipod

walks on bottom

Aquatic Sowbug or Isopod

Four Pairs of Legs

tiny, often brightly colored

Water Mite

runs on top of water

Fishing Spider

Three Pairs of Legs

Wings

Beetle-Like, Wings Hard

small, crawls on bottom

Riffle Beetle

swims moving hind legs alternating

Water Scavenger Beetle

back legs move at same time

Predaceous Diving Beetle

swims on surface

Whirligig Beetle

"Crawls" through water, spotted

Crawling Water Beetle

Leathery Wings

tan, lives on surface

Marsh Treader

dark, lives on surface

Water Strider

grasping front legs, up to three inches

Giant Water Bug

swims on back, back white

Backswimmer

swims right-side-up, back black

Water Boatman

long breathing tube, grasping front legs

Water Scorpion 'Nepa'

long, stick-like

Water Scorpion 'Ranatra'

No Wings

No Obvious "Tails"

brown, leatherlike, six legs, usually "C"-shaped

Riffle Beetle Larva

six legs and prolegs on abdomen

Pyralid Caterpillar

suction cup-like

Water Penny

large body, hinged mouth

Dragonfly Larva

green, tan, orange or white body

Caddisfly Larva

lives in stone case

Caddisfly Larva

lives in stick house

Caddisfly Larva

One or Two "Tails"

dark head, green or tan body, two brush-like tails

Caddisfly Larva

small, "spines" on side

Alderfly Larva

large mouth parts, "spines" on side

Dobsonfly Larva

"tails" long and stiff, long antennas

Stonefly Larva

flat gills on abdomen

Mayfly Larva

hangs from surface, large mouth parts

Predaceous Diving Beetle Larva

Three "Tails"

long "tails," gills on abdomen

Mayfly Larva

long "tails," gills on abdomen

Mayfly Larva

large legs, feathery gills

Mayfly Larva

plate-like "tails," no gills on abdomen

Damselfly Larva

Microscopic

Suckers, expands and contracts, body segmented

Leech

reddish brown, segmented body

Tubifex Worm

glides along bottom, body not segmented

Flatworm or Planaria

tan to brown, long

Horsehair Worm

body with bristles, no suckers

Bristle Worm

distinct head, red, green or tan, twists

Midge Larva

small, hair-like, swims in "S" shape

Nematode or Threadworm

Worm-Like

apostrophe-shaped

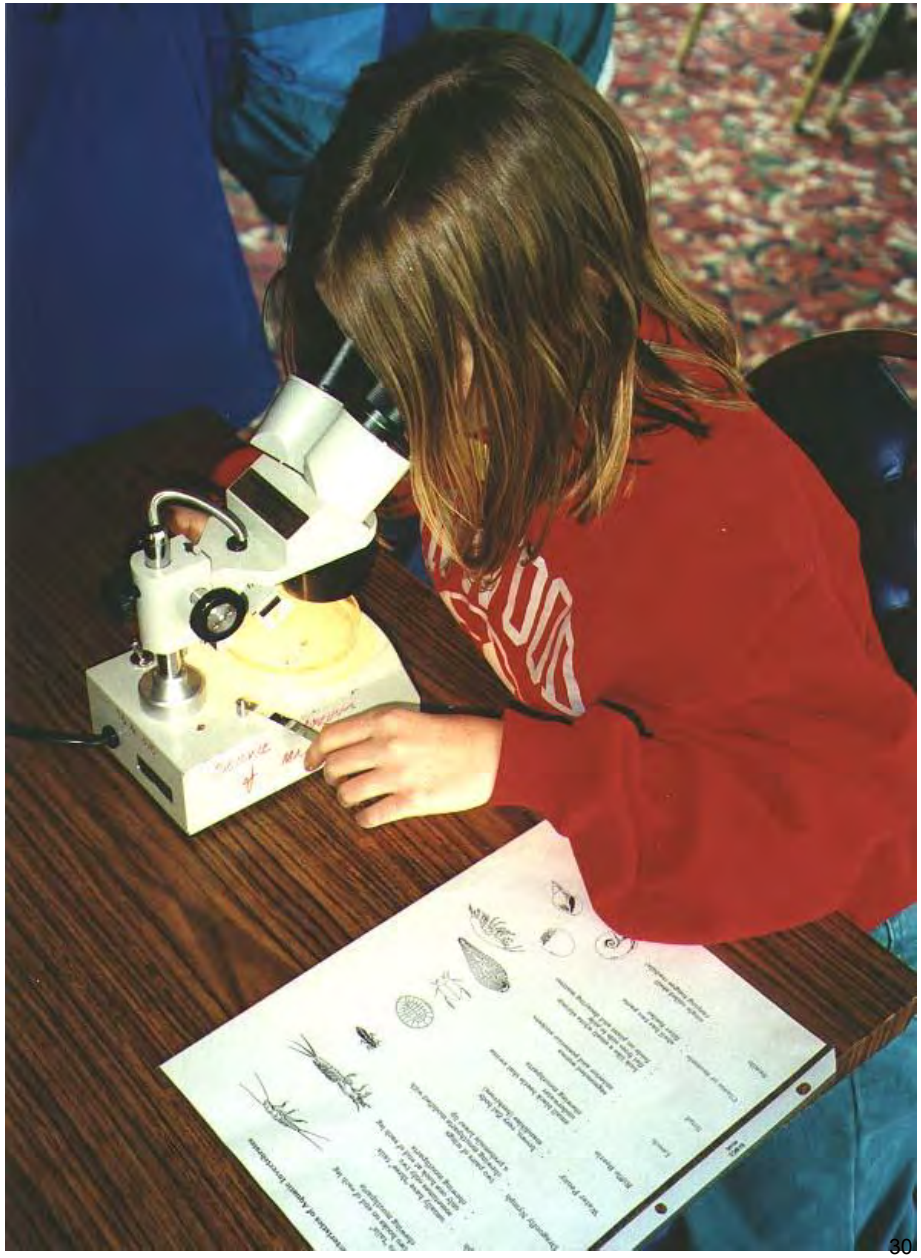
Cyclops or Copepod

round

Seed and Clam Shrimp

swims with a jerk, using antennas

Water Flea or Daphnia



Aquatic Macro Invertebrates

and

Big River Journey

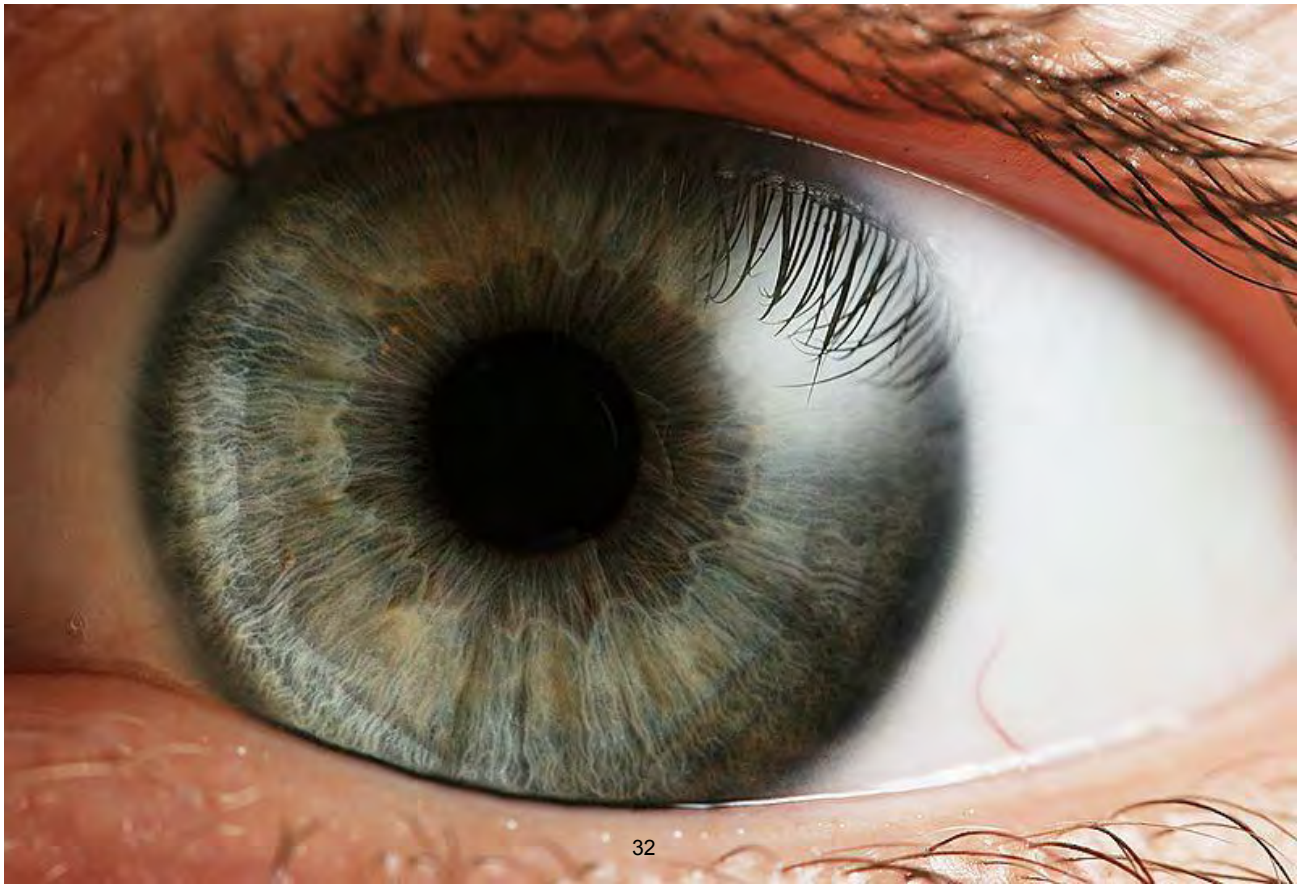
Aquatic Macro Invertebrate

Aquatic = water

Aquatic Macro Invertebrates

Aquatic = water

Macro = visible with your eyes



Aquatic Macro Invertebrates

Aquatic = water

Macro = visible with your eyes

Invertebrate = animal without a spine

. . .like a mayfly

On the Big River Journey Boat, you'll see. . .

Aquatic Macro Invertebrates!

Aquatic invertebrates

These are tiny organisms, such as insects, that live in lakes, ponds, and rivers. We hardly noticed them, but they serve an important role. They feed on algae and other plants and are the base of the aquatic food chain.

-- daphnia (water flea)

--amphipod

What's an aquatic food web or food chain?

- It's the story of **what eats what**. It includes everything that lives in or near the water:

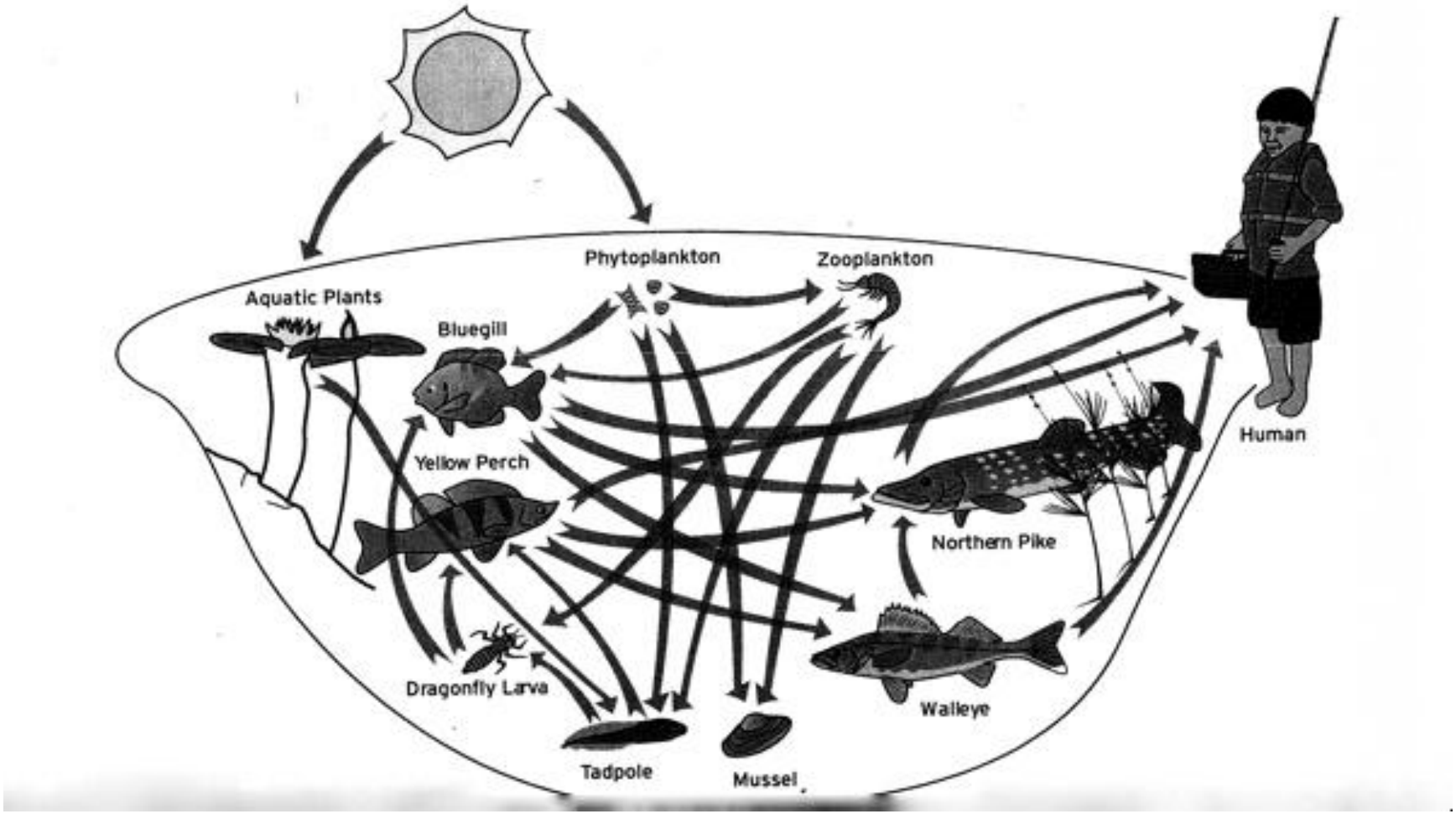
  Big things: people, turtles, raccoons, fox, eagles, ducks, birds, big fish, little fish, seaweed,frogs, clams and mussels.

  Little things: macro invertebrates,insect eggs, snails, algae, aquatic worms, tadpoles, phytoplankton (tiny aquatic plants), zooplankton (tiny aquatic animals).

Aquatic Food Web or Chain

http://www.qeallc.com/html/bioaccumulation.htm

Aquatic Food Web



Source: MinnAqua: Food Chain Tag

Did you know?

Many aquatic invertebrates, like this damselfly, spend their nymph stage in water. A nymph is the stage of development between egg and adult.

When the nymph development is complete, the mature nymph climbs from the water and flies off to begin its adult stage. It then breeds and returns to the water to lay eggs. The cycle begins again.

Insect Metamorphosis

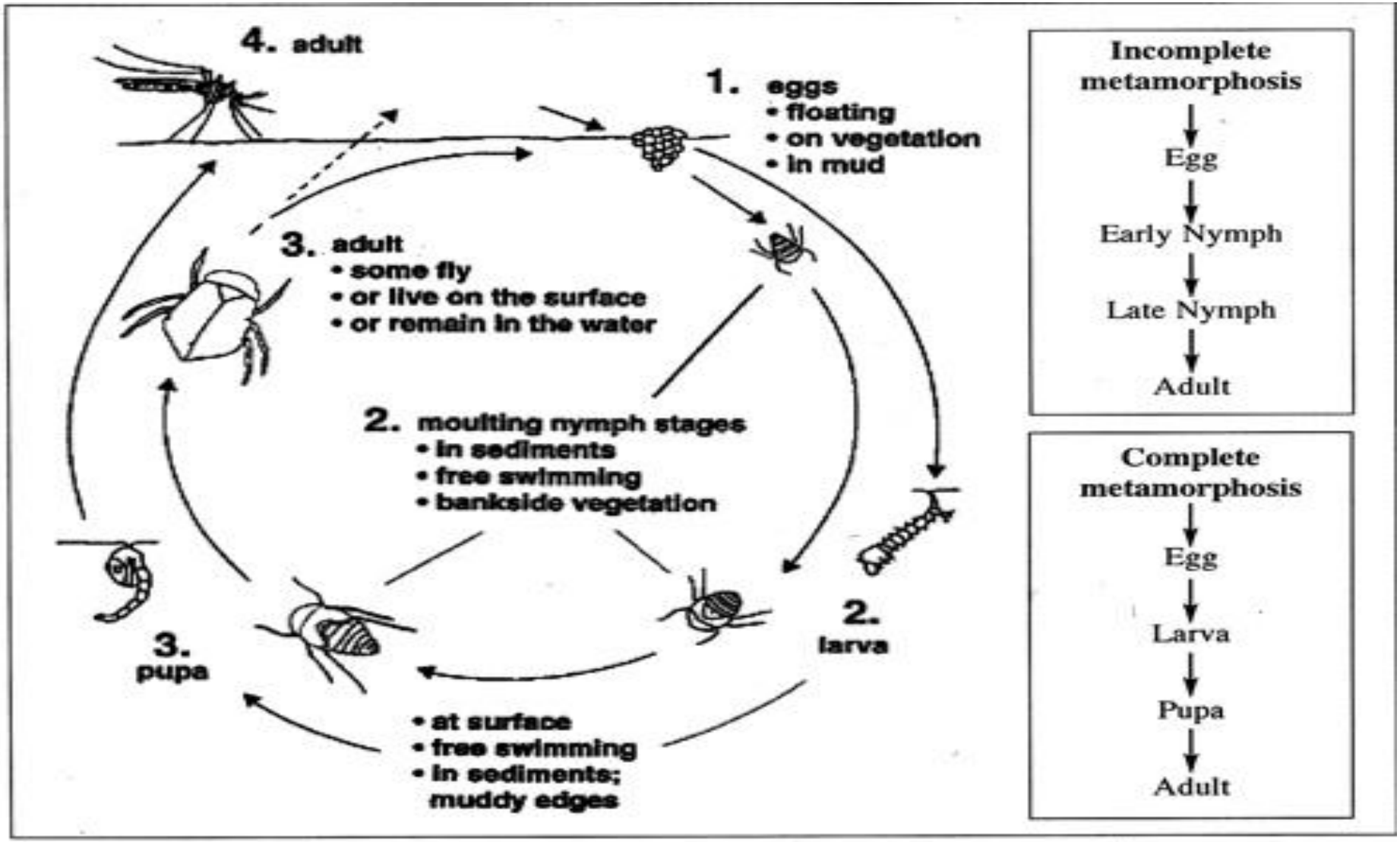


Figure 1: Insect life cycles

www.watershed.nau.edu

Mayflies may spend two years as nymphs living in water before developing into adults and flying in the air. After hatching as adults, they live from a few hours to three weeks. As adults, they do not eat--they have no mouth parts! The job of adult mayflies is to mate during their short life. Females return to the water to lay their eggs.


A Mayfly hatch on
Lake Superior
Mayflies are highly sensitive
and can only live in clean water

The Mosquito

Mosquitos undergo **four stages of development** over a 15- 20 day period.

1) They begin life as an **egg** laid on the surface of ponds and quiet waters.
2) In the **larval stage** (left), they hang and breathe from the water surface, and feed on algae and microscopic animals.
3) In the **pupa stage**, they also hang from the water surface and may swim about.
4) When they emerge as **adults**, they rest on the water surface to dry their wings then fly off to mate and return to the water to lay their eggs. If the female has had a blood meal, more eggs will develop. Yes, only female mosquitos bite.

Giant Water Bug

- Giant Water Bugs can grow to 3”
- They use their forelegs to grasp and hold a tadpoles or other insects as they thrust in their sucking mouthparts.
- They live in lakes and ponds.

Macro Invertebrates can tell us if the water is clean or dirty.

- Some can survive in <u>both clean and polluted water</u>

--leeches

--snails

Macro Invertebrates can tell us if the water is clean or dirty.

Some can survive in <u>medium clean water</u>

Dragonflies: the nymph stage (left) lives in the water 3-4 years before emerging as a flying adult dragonfly (right)!

Macro Invertebrates can tell us if the water is clean or dirty.

- Some can survive ONLY in clean water

--mayflies

--caddisflies

Macro Invertebrates can tell us if the water is clean or dirty.

- Every species of animal has a range of physical and chemical conditions in which it can survive.
- Some invertebrates are sensitive and will not survive in polluted waters, others will tolerate a little to a lot of pollution.
- In the cleanest ponds, lakes, and rivers, you'll find the greatest diversity of aquatic invertebrates.
- In polluted waters, only a few species can survive.

Kinds of Ponds--Clean!

+ Natural shoreline with a variety of plants
+ no man-made structures
+ room for lots of wildlife

Kinds of Ponds--Medium Clean

+ Natural shoreline
+ grasses at shore
- Rain runs off from parking lots (cars leak oil and this washes into the water)
- Urban area with limited wildlife habitat

Kinds of Ponds--Polluted

- No plants next to shoreline
- chemical pollution
+ Some trees might attract wildlife

Arizona

Collecting Specimens

- Take the “D” Net and a bucket to the pond
  - -->drag the net through the weeds along the shore in the shallow water
  - -->Examine net for invertebrates, hand pick out inverts and place into bucket
  - . . .Repeat

--Stop and listen to the sounds of nature

Aquatic Invertebrates in the Winter

- In the winter, invertebrates are inactive.
- They've adapted to survive over-wintering, freezing and then thawing.
- Insect eggs wait in the mud for the water to warm in the spring.
- Algae still grows and fish swim about.

See you on the River Boat!

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- BRJ photos and others by Kate Hintz, Science Museum
- Photos from vernalpool.org, used by permission
- Lyndon Torstenson, NPS

Birds, Beaks, and Adaptations

Objective: The student will learn and describe how different kinds of bird beaks have adapted to feed on different foods within a specific habitat.

Materials:
Simulation habitat equipment
2 containers of water: one shallow (2" of water), one deep (10" or more water)
4 tweezers
4 tongs with tape over tong
4 long handled salad tongs
4 pliers
1 package of rice or popcorn
1 packages of sunflower seeds
1 stump with holes in it for rice or popcorn
any floating and non-floating objects, such as cut-up straws 1/2 inch long, raisins

Procedure:
Tell the students that they are going to become different kinds of birds. Show them the different "beaks." These include the tongs, tweezers, and other utensils. Explain to the group that their job is to find the proper habitat for which each bird is suited. Mention that the tools or "beaks" give some clue of what a bird eats and where it may live.

Show the students four habitats. See **Simulated Habitats** (Insert A). As you move into each new habitat, give a short description of the habitat to create a mood. The four habitats are marsh, pond, forest, and prairie.

Divide students into groups of four. Each group receives a different tool (i.e. one group receives pliers; one group receives tweezers, etc.). Groups will keep the same tool throughout the whole activity. Tell the students they will move from one habitat station to the next. They will have 30 seconds at each habitat station to eat as many food items as possible. The students must keep one hand behind their backs and cannot let their hand get wet.

For Food to qualify as eaten:
Marsh: Floating objects must be dropped in another container and hands can't touch the water.
Pond: Sinking objects or other non-floating objects must be dropped in another container and hands can't touch the water.
Forest: Rice/popcorn must be dropped in another container, can't be dropped on the floor.
Prairie: Sunflowers must be crushed over a container and the nut taken out.

Emphasize to students that they are not competing against one another. Remind them that they are trying to find the habitat that they are best suited to. Have the students record the number of food pieces eaten on the **Habitat Record Sheet** (Insert B).

Birds, Beaks, and Adaptations

Simulated Habitats

Marsh	=	Pail with shallow water and surface floating objects
Pond	=	Pail with deep water and raisins or other non-floating objects
Forest	=	Log with holes and rice/popcorn to put into holes
Prairie	=	Sunflower seeds on a table

Some Facts to Help You Out

Forest Habitat - Woodpeckers

- corresponds to tweezers
- eats insects

Adaptations:

1. Long, sharp, "chisel" bill for hammering into tree trunks.
2. Stiff tail feathers used as prop to hold the bird upright on the side of the tree.
3. Long tongue that wraps around inside of skull - aids in extracting insects.
4. Toes - two face forward, two face backward for better vertical support on tree trunk.
5. Barbed tongue for extracting insects.

Prairie Habitat - Grosbeak, sparrow

- corresponds to pliers
- eats seeds

Adaptations:

1. Heavy, conical bill with sharp edges for splitting seeds open. Strong jaw muscles.
2. Flocking behavior in winter because food may be concentrated in fields or "weed" patches.
3. Toes - three face forward, one behind for perching and hopping.

Marsh Habitat - American bittern, heron, tern

- corresponds to long handled salad tongs
- eats fish, frogs, large insects

Adaptations:

1. Long neck for plunging into water.
2. Sharp bill for spearing fish.
3. Long toes for walking on mud and grasping clumps of vegetation.
4. Coloration for blending into marsh vegetation.

Pond Habitat - Puddle duck

- corresponds to short tongs
- eats aquatic vegetation near the water surface

Adaptations:

1. Fringed or fluted bill for straining food from the water.
2. Webbed feet for propulsion through water. Also act as "snowshoes on mud."
3. Legs short, far back on body for swimming.

Insert B - Habitat Record Sheet

Birds, Beaks, and Adaptations

Directions: Have all groups record the number of food pieces “eaten” from each habitat with each tool.

HABITATS

	Pond	Marsh	Forest	Prairie	**RESULTS**
BEAKS Pliers					
Short Tongs					
Long Tongs					
Tweezers					

Birds, Beaks, and Adaptations

VOCABULARY

Adaptation: The process of making adjustments to the environment through behavior, physical feature or other characteristic that will help a living thing survive in its environment.

Habitat: The surroundings in which an animal lives where all needs for life are found. This includes food, water, shelter, and space in a suitable arrangement.

Fresh Water Marsh: A wetland where standing fresh water exists year round in most conditions.

Pond: A still body of water smaller than a lake, often shallow enough that rooted plants can grow throughout.

Forest: A community of plants and animals in which trees are the most dominant member.

Prairie: A grassland community; a vegetative community in which grasses are the most dominant member.

Wetland: A wet land with specialized soil and plants, frequently or continually flooded, found on the edges of rivers, creeks, ponds, lakes, isolated depressions, or along the ocean, bay or estuaries.

Birds, Beaks, and Adaptations

Optional River Modifications

This page provides teachers with options to enhance this activity, including more river habitats. These ideas represent what we at the Mississippi National River and Recreation Area have found to work, but you may modify the activity to meet your needs and your class size.

Optional Additional Habitats:

Field & River Habitats – Hawk, Bald Eagle

- Corresponds to scissors or wire cutters
- Eats mice, snakes, rabbits

  Adaptations:
  1. Sharp, hooked bill for ripping and tearing flesh
  2. Long, sharp talons, or claws, on strong toes for grabbing and holding prey
  3. Excellent eyesight for detecting the movement of prey in grass

Open Air Above River – Swallow, Nighthawk

- Corresponds to minnow/aquarium net
- Eats flying insects

  Adaptations:
  1. Net-like bristles around mouth to capture insects in flight
  2. Very good at maneuvering in the air to catch insects while flying

River Shallows Habitat - To incorporate more of the River ecosystem, change the Marsh Habitat to a River Shallows Habitat.

Garden/Floral Habitat - Hummingbird

NOTE: This habitat requires a bit more set-up, and some specialized equipment; the "flowers" can be found at farm supply stores.

- Corresponds to syringe or eye dropper
- Eats nectar from flowers (favors red flowers)

  Adaptations:
  1. Long, thin, straw-like beak for sipping nectar from flower centers
  2. Hover in the air while feeding by flapping wings very rapidly
  3. Only bird that can fly backwards, to leave the flower they are feeding on

Suggestions for class/group management:

It is best if each student has a distinct job to perform. Dividing students into groups of four keeps the group size manageable and provides each student a role to play.

A group of 28 students can be accommodated if all seven habitats are used; marsh, pond, forest, prairie, field and river, open air and garden/floral.

In each of these groups, there will be four jobs to be performed, one for each student. The students should rotate which job they perform each time they come to a new habitat, so everyone has a chance to try out all the jobs. The four jobs are:

- The Bird – This person will use the beak which the group selected in the beginning of the activity to gather as much food as possible (the same beak will be used by the group at each of the habitats).
- The Timer – This person will use a watch or the classroom clock to time the "bird" as he/she "eats" food (30 seconds should be allowed).
- The Counter – This person will count the number of food items "eaten" by the "bird" in the habitat.
- The Recorder –This person will record the number of food items that the Counter has counted in the chart (each group has one chart), and then record the same number on the master classroom chart for their group.

Other jobs that could be held by extra students (i.e. more than 28) include:

- Judging to make sure the "birds" are only using one hand to operate their beak, and that hands don't get wet in the Marsh or Pond Habitats
- Using an egg timer, set for 2 minutes or so, to call for groups to change habitat stations (they should have gathered food for 30 seconds, and finished all their counting and recording by this point)

HABITATS

BEAKS	Pond	Marsh	Forest	Prairie	Field/river	Open air over river	Garden/ Floral	RESULTS
Pliers								
Scissors								
Pencils **(Replaces Long tongs)**								
Syringes								
Minnow Nets								
Tweezers								
Short Tongs								

Web of Life Game *

Objective: The students will learn how animals compete for resources and the impacts an exotic species can have on a natural ecosystem.

Time requirement: 20-30 minutes

Materials:
identity tag* for each student – for a class of 30, the tags should be made as follows:
- 10 small fish * use copies of photos from Native Fish and Mussels
- 10 native mussels
- 10 larger "predator" fish
- write “ZEBRA MUSSEL” on the back of each identity tag

150 Blue game pieces (these pieces represent dissolved oxygen)
150 Red game pieces (these pieces represent zooplankton)
cones or flags for game area boundaries
pencil and paper to record the results of each round for later discussion

For the game pieces, you can use colored popsicle or craft sticks, colored plastic spoons, colored paper, poker chips, or anything that will not blow away (if played outdoors) and can be easily picked up after the game is over.

Introduction: Zebra mussels are just one of many exotic species that have “stowed away” in ships from Europe and Asia and now live in the Great Lakes and the Mississippi river. (See the enclosed, “A Field Guide to Aquatic Exotic Plants and Animals" for more information). Like many exotic species, zebra mussels have an ecological impact on the areas they inhabit, out-competing native species for food and oxygen. In the "Web of Life Game", students will take the roles of the species most directly impacted by the zebra mussel to discover the delicate balance in a river ecosystem.

***** This activity is adapted from "Zebra Mussel Mania Teacher's Guide," Illinois-Indiana Sea Grant Program.

Web of Life Game

Setting up the game: the following instructions are based on 30 students.
Adjust the numbers as needed using a starting ratio of 1:1:1.

Object of the game: to survive as long as possible.

Directions for students

Round One:

1. Students put on the nametags with the fish or mussel picture facing out and the teacher scatters the food and oxygen pieces in the playing area. Record the starting numbers of each species.
2. At a signal from the teacher, all fish and mussels scramble to get as many game pieces as possible.
3. When all of the game pieces have been gathered up, regroup to determine who has survived based on the following chart.

	Dissolved Oxygen	Zooplankton
small fish	**4**	**4**
native mussels	**4**	**4**
larger "predator" fish	**8**	**8**
ZEBRA MUSSEL	**2**	**2**

4. Species must have at least the required number of each game pieces to survive. Survivors remain in the game for the next round. Record the numbers of survivors. Species who did not have the required number of game pieces die and are "recycled" into Zebra Mussels for the next round. . . they should turn their species tag over to display **Zebra Mussel.**

Round Two:

5. Collect and rescatter the game pieces. Again, at a signal from the teacher, have students collect as many game pieces as they can.
6. Repeat the counting process to determine who survived, recording the numbers of survivors after each round. If many animals besides **Zebra Mussels** survive, repeat another round or two.
7. The results may be different each time the game is played. If you choose, play the game again in the same manner or using different starting numbers of species for different results.

Shovelnose sturgeon – to 34”; bottom of main channels

Paddlefish – to 87”; plankton eater; slow moving water of large rivers

Bowfin – to 43”; swamps, sloughs, pools and backwaters near vegetation

Mooneye – to 18 ¾”; eats aquatic invertebrates and small fish

Sucker family: vacuum up invertebrates from river bottoms

Bigmouth buffalo – to 40”; main channels, pools and backwaters

Quillback – to 26”; pools, backwaters and main channels

Shorthead redhorse – to 29 ½”; rocky pools, runs and riffles

Channel catfish – to 50”; deep pools and runs over sand or rocks

Shortnose gar – to 33”; predator; quiet pools, backwaters and swamps near submerged logs and vegetation

Drum family: males make drumming noise under water

Freshwater drum – to 35”; bottom of rivers: eggs and larvae float at surface of water; eat zebra mussels

Sunfish family: males build nests and guard eggs and young

Rock bass – to 17”; predator; pools in rivers and near brushy stream banks

Smallmouth bass – to 27 ¼”; predator; live in flowing pools

Perch family: eat insects, crustaceans, and fish

Walleye – to 36”; backwaters and runs of rivers, usually in clear water near brush

Mussels

the larval stage (called glochidia) live in the gills of specific host fish for a short time

Fragile Papershell – host is the freshwater drum

Pink Heelsplitter – host is the freshwater drum; decreasing in numbers

Higgins’ Eye – hosts are saugers and freshwater drums; endangered species

Hickorynut – host is the shovelnose sturgeon; healthy population

Deertoe – hosts are saugers and freshwater drums; healthy populations

zebra mussel

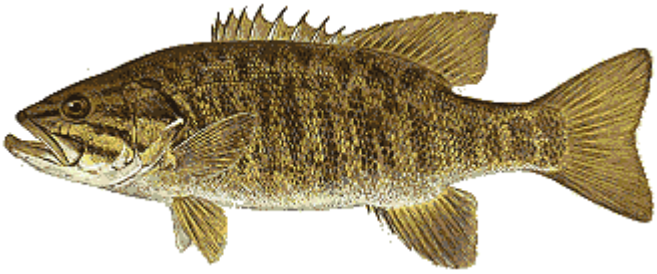
zebra mussel

zebra mussel

zebra mussel

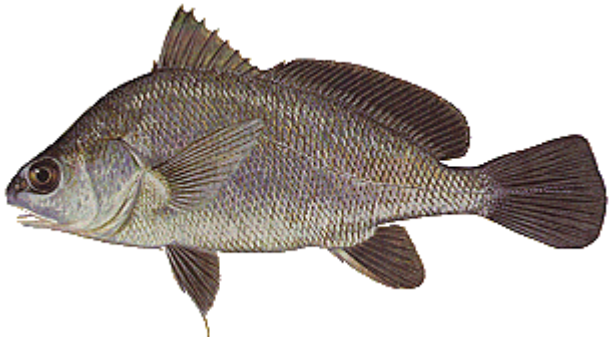
Native Fishes and Mussels of the Mississippi River

Channel Catfish



Smallmouth Bass

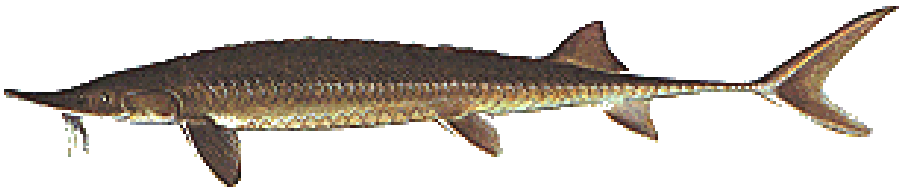
Walleye



Freshwater Drum

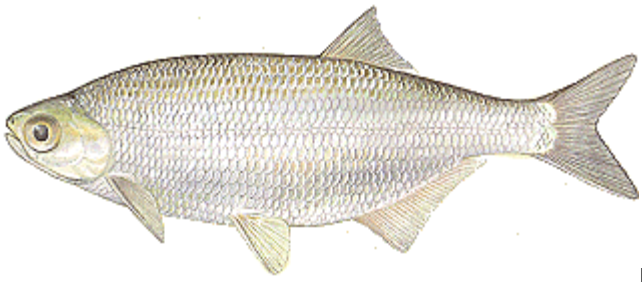
Bowfin

Shortnose Gar

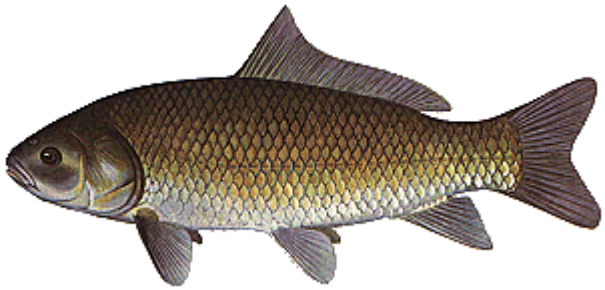


Shovelnose Sturgeon

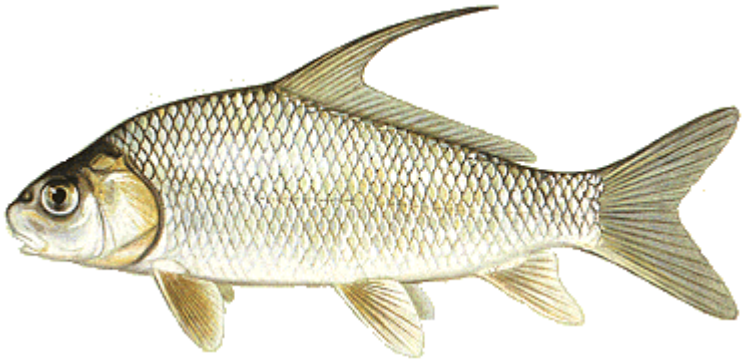
Paddlefish



Mooneye

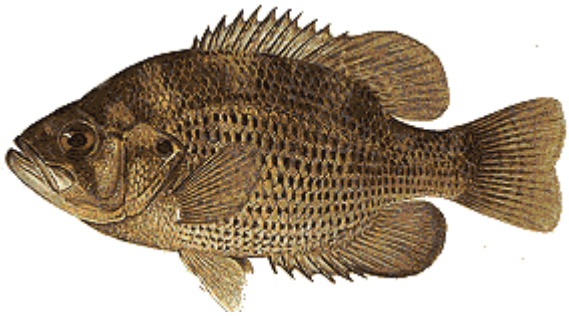


Bigmouth Buffalo



Quillback

Shorthead Redhorse



Rock bass

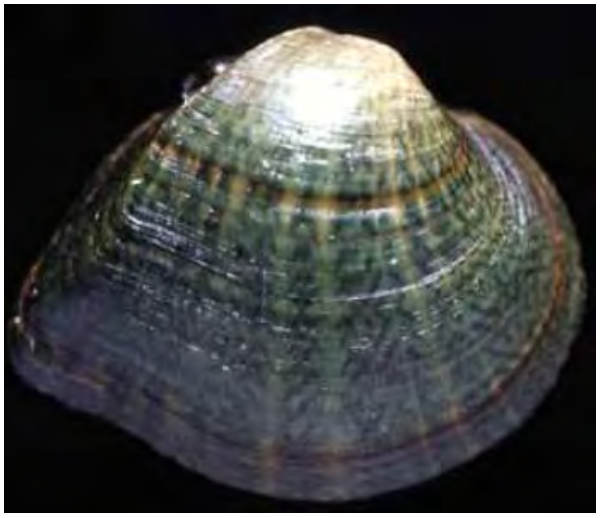
Mussels of the Mississippi River


Fragile Papershell


Pink Heelsplitter


Higgins Eye

Hickorynut



Deertoe

Non-Native
Zebra Mussel
(USGS)

River Ecosystems

Pre-trip activity ideas:

Play the " Web of Life Game" and then answer the following questions.

- Who is at the top of the food chain?
- Who is at the bottom of the food chain?
- What happens when one species is removed?
- Which populations increase or decrease? Could any populations go extinct?
- Are all the parts of a food chain important?
- What can happen when an exotic species is introduced into an ecosystem? What exotic species are present in the Mississippi River?

Have the students research which plants and animals would have lived in and along the Mississippi River 200 years ago.

- Which plants and animals live here today?
- How have the land and the river changed?
- List some ways that people can use and change rivers.
- How might these uses or changes effect the ecosystem?

Have the groups research two or more Ecosystems (examples: desert, grassland, forest, marsh, rainforest, tundra)

- Draw pictures of the different ecosystems and their plant and animal communities
- Compare and contrast the different ecosystems.
- How are the plants and animals the same? How are they different?
- Which plants or animals occupy the same niche?
- Which plants or animals are found in more than one ecosystem?
- Which plants or animals are unique to an ecosystem?
- Which ecosystems are native to Minnesota?

Use the article The flood pulse: Heartbeat of a River, by Dean Rebuffoni from the April 16, 1997 Minneapolis Star Tribune to discuss seasonal cycles and how they can affect ecosystems along a river.

River Ecosystems

Post-trip activity ideas:

Compare the Observations made by the three Ecosystems groups during the trip.
- What different ecosystems were observed?
- What species of plants and animals were observed?
- How high was the water? Was there evidence of how high the river has been in the past?
- What evidence was there of flooding?
- What are some of the adaptations that plants and animals have for living in a floodplain?
- How are people changing the floodplain ecosystem? How do people have an impact on flood levels or the frequency of floods

Have the students research the natural history of a plant or animal found in a river ecosystem and answer the following questions about their species.
- What does it look like? (Draw a picture)
- Where does it live? (habitat and community or ecosystem)
- What does the species do that makes it different from others? (its niche)
- Is it a producer, consumer, or decomposer?
- Where does it get its energy from?
- Is it an herbivore (plant eater), a carnivore (animal eater), or an omnivore (both)?
- What eats it? (who does its energy go to)

Have the students draw pictures to construct a 4-5 link food chain using their species.
- Discuss how these food chains are just a small part of the whole system called the food web. Use the pictures each student made of their species to construct a food web bulletin board. Use arrows or pieces of yarn to show the species that are connected in the food web.
- Notice that some plants and animals are eaten by more than one species.
  - Why is it important to have many pathways of energy flow in an ecosystem?
  - Which species are eaten by more than one other species, those at the top or those at the bottom of the food chain?
  - What does this suggest about the population sizes of species at the top and bottom of the food chain?
  - Which plants and animals occupy the same niche?
  - What happens when a species is eliminated from the ecosystem?

Suggested Resources: Minnesota's St. Croix Valley and Anoka Sandplain: A Guide to Native Habitats, from the Minnesota DNR; animal and plant fact sheets from the DNR or Minnesota Valley National Wildlife Refuge.

River Ecosystems Vocabulary

Basic Vocabulary:

habitat - the place where a plant or animal lives and finds the resources it needs

predator - an animal who eats other animals

prey - an animal that is eaten by another animal

niche - the role or function a plant or animal has in a community

population - all of one kind of plants or animals in a specified area

native species - a species originally living or growing in a certain place

exotic species - a plant or animal introduced from a different area that competes with the native species

endangered species - a species in danger of extinction (dying out)

food chain - a series of plants and animals within an environment of which each kind serves as a source of nourishment (food) for the next in the series

food web - a complex, interlocking series of individual food chains

Intermediate Vocabulary:

ecosystem - a group of plants and animals that interact and adapt to a physical environment, including climate, water, air, and soil (desert, tundra, rain forest, etc.)

competition - the struggle between individual organisms for food, water, space, etc., when the available supply is limited

watershed - all the land that water flows over or under on its way to a stream, river or lake

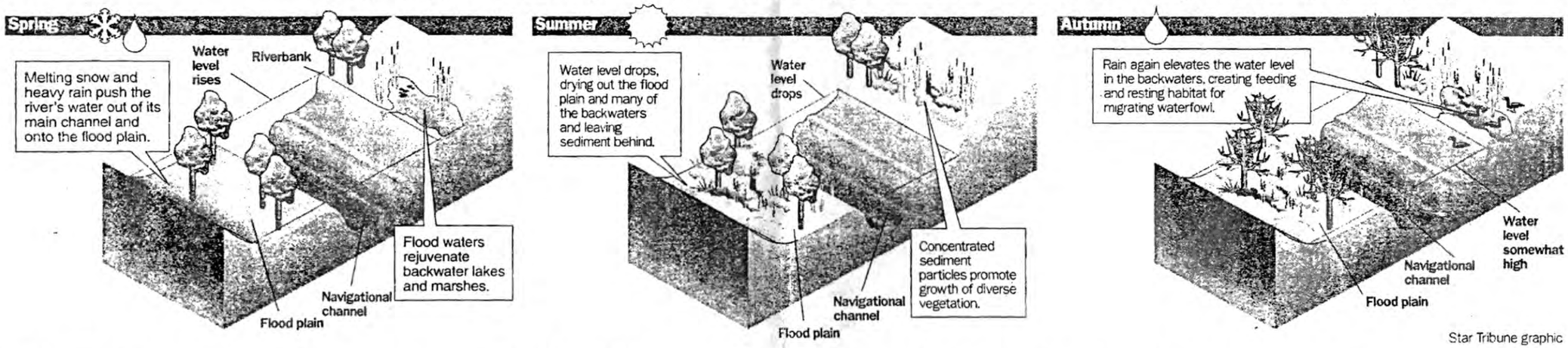
floodplain - the flat area of land adjacent to a stream or river that is created by erosion and deposition of sediments during regular flooding

flood pulse - the seasonal rise and fall of the water level, which controls plant and animal life in the river's channel, backwaters and floodplain

The flood pulse:
Heartbeat of the river

The flood pulse is the natural heartbeat of rivers such as the Mississippi and the Minnesota. The pulse is the seasonal rise and fall of the water level, which controls plant and animal life in the river's main channel, backwaters and flood plain. All are interconnected, complex ecological systems that naturally rely on the flood pulse to rejuvenate and replenish.

On many rivers — including the Mississippi and, to a lesser degree, the Minnesota — the flood pulses have been altered by the works of humans: dams and levees, for example, and an accelerated influx of sediment — largely sand and silt — that enters the rivers and their backwater lakes, marshes and sloughs from farm fields and other sources.



Star Tribune graphic

Waters' rise and fall essential to health of rivers

Though disastrous to human efforts, floods rejuvenate the ecological system, and along with droughts create a vital cycle.

By Dean Rebuffoni
Star Tribune Staff Writer

When the turbid waters of the Mississippi and Minnesota rivers recede, the question will be asked: How much damage did the flood cause? And the answer probably will be in the tens of millions of dollars.

That's the economic harm. Less easily determined is the flood's effect on the rivers' ecosystem. And while that cannot clearly be measured until several years have passed, it surely will be a combination of good and bad.

Simply put, major floods serve a vital function: rejuvenating and replenishing the natural ecological system. Floods and drought, another natural and recurring process, create the "flood pulse" essential to the health of rivers.

People should not be surprised to learn that floods can have positive effects, said Richard Sparks, an expert on large flood-plain rivers.

"The productivity boost provided by the annual flood was identified long ago," he said. "The Egyptians along the Nile, and the people in Mesopotamia between the Tigris and Euphrates rivers, knew about it. Those rivers flooded their fields, providing fresh nutrients and silt to the soil.

"Flood-plain rivers really gave rise to human civilization . . . providing the only way for large concentrations of people to stay in one place for a long time."

Sparks is an aquatic biologist with the Illinois Natural History Survey, a state agency.

During an interview Tuesday and in an article he wrote, Sparks explained the ecological effects of the 1993 flood along the Mississippi from the Twin Cities downstream. His article drew on his research and that of other scientists.

Similar effects occur in the flood plain of the Minnesota River, especially its lower stretch in the Twin Cities area. The Red River in northwestern Minnesota, which also is flooding this spring, is a smaller stream with some different characteristics.

Sparks noted that during major floods on the Mississippi, the flood plain becomes part of the river itself, as the high water moves through forests, marshes and farm fields. That causes these effects:

➤ **Fish.** By spreading its waters across its flood plain, the Mississippi created a vast expanse in which its fish could feed, spawn and hide. The fish that hatched in the spring of 1993 on the inundated flood plain immediately found an abundance of tiny organisms on which to feed.

When the flood waters receded, the young fish were concentrated into much smaller, deeper areas and into the jaws of larger predators — largemouth bass, for example, and channel catfish.

"Humans view this winnowing process as advantageous because biomass produced on the flood plain moves up the food chain into larger fish sought by both commercial and sport anglers," Sparks said.

➤ **Aquatic plants.** As the flood waters of the Mississippi rose in Minnesota and Wisconsin, submergent aquatic plants grew so they could reach the life-giving sunlight. During the height of the flood, many aquatic plants were uprooted and were seen floating down the river's main channel.

Some native plants, including wild celery, an important waterfowl food, are adapted to floods and in some areas benefitted from the high water. Less well adapted was an unwanted alien plant, Eurasian water milfoil. By the following summer, in 1994, the native had replaced the invader in some river backwaters.

➤ **Trees.** To the average observer, flood plain forests appear to scarcely change from year to year. Therefore, the death of many trees during or after a major flood appears catastrophic.

"In actuality," Sparks said, "the diversity of the vegetation on the flood plain is a product of disturbances such as major fires, droughts and floods that occur very infrequently, in terms of a human life span."

The average mortality among all species of trees along the Mississippi in 1993 ranged from undetectable in Minnesota to a high of 37 percent near St. Louis. That was to be expected: The flood lasted longer and was more severe in downstream states.

Still, floods and other major disturbances determine the diversity of trees and other vegetation on the flood plain. Many seeds cannot germinate and grow in the shade of mature trees, so old trees must die before new ones can grow.

"Without great floods, cottonwood trees could gradually be replaced by hackberry trees and elms because cottonwood seeds only germinate on moist mud, and the seedlings cannot grow in the shade of taller plants," Sparks said. "Elm and hackberry, however, can grow in shade and eventually reach through the low canopy to form a higher canopy of their own."

➤ **Zebra mussel.** This alien invader, which was accidentally introduced into the United States, kills native clams and clogs water intakes. The 1993 flood carried the mussel larvae deep into the Mississippi's backwaters and upstream into tributary streams that were backed up by the river.

"Still another potential pest was introduced when a fish farm on a tributary of the Mississippi flooded out and Asian black carp escaped," Sparks said. "It's ironic that sterile black carp were to be developed and tested as a zebra mussel control.

Richard Sparks' comments on the ecosystem effects of major floods are drawn from "The Great Flood of 1993: Causes, Impacts and Responses," edited by Stanley Changnon, Westview Press, 1996.

Big River Journey Classroom Activity: Boats

Build an Aluminum Foil Boat

Objective: Design a boat that will float and hold many pennies; evaluate the design.

Science Concept: buoyancy. A fluid exerts an upward force on objects less dense than itself. An object floats if water's density is greater than the object. By enclosing air, which is much lighter than water, even steel boats can float. Without buoyancy, river and sea transportation, exploration and commerce would not have been possible.

Materials:
sheets of aluminum foil, approximately 12" x 6" (keep the size uniform)
tubs of water
pennies, up to 100 per tub
bowls for pennies
1 tsp bleach per tub
paper or cloth towels
2 buckets for used foil and hand towels.

Prep
Fill tubs with 3"- 4" of water. Add 1 tsp of bleach to each tub. Cut foil into uniform sizes sheets. Put pennies in bowls. Provide towels to mop up spills.

Directions to students
1. Shape a piece of aluminum foil into a boat shape.
2. Float the foil on water.
3. Add pennies until the boat sinks.
4. Count the number of pennies the boat held.
5. With a new sheet of foil, redesign the boat hull and repeat test.
6. Record the number of pennies held and student's name on the board.

Questions for students:
1. What can you say about your hull design?
2. What is the equivalent "boat" to your design? Canoe, barge
3. How does the placement of pennies affect the number the boat holds?
4. What kinds of boats are used on the Mississippi River to haul cargo? Why? What advantages do barges have over deep hull boats?

Note to teacher: Give students the opportunity to be as creative as possible with the hull shape. Make no suggestions, unless to show how to fold up one side to make an edge. The best designs are flat barges with small sides. The placement of pennies also makes a difference in the number held. The record for one sheet of 8" x 12" foil is around 280 pennies. Recycle the foil along with your pop cans.

How Does a Steel Boat Float?

By Captain Jim Kosmo
Vice President, Padelford Packet Boat Co., Inc.

We all know that many objects actually will float on water, but a piece of steel will quickly sink to the bottom; so, why does a 250 ton steel riverboat such as the Harriet Bishop float? Well, actually it is the same reason that wood, styrofoam or other items float – AIR.

Most any material can be made to float if you can enclose enough air in a watertight space. Wood and other materials that float naturally will be seen to have many tiny watertight pockets of air inside them when viewed under a microscope.

To make a piece of steel (or aluminum foil) float you first must form it into a watertight shape that encloses air. The larger the watertight space the better your steel vessel will float.

Once you have mastered this step you are well on your way to building a boat. At this point you will begin to realize that a good riverboat captain better have a good background in mathematics. Mathematics is critical in determining the safety of the vessel and how much weight it can handle. Math also is required for plotting your course, but that is another lesson.

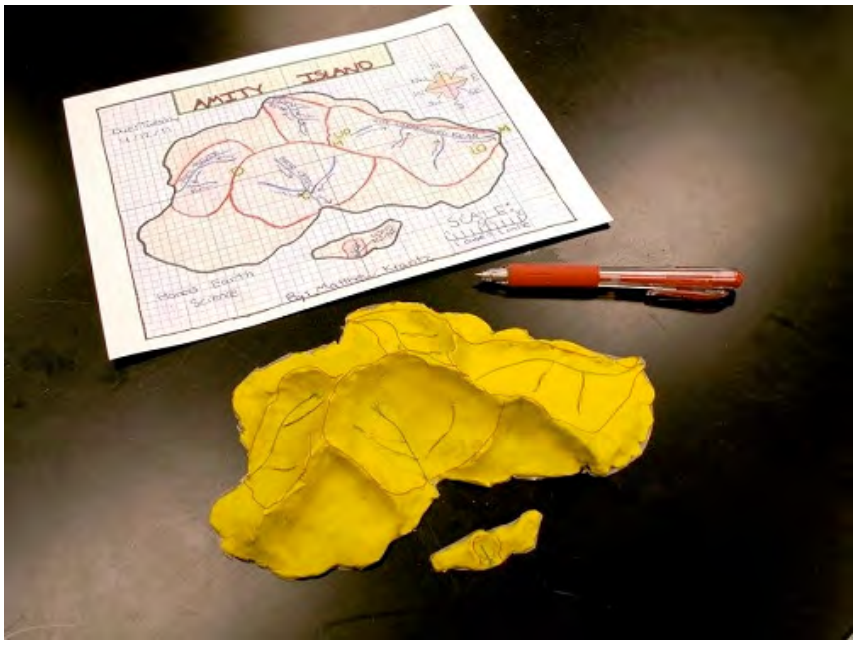
Before leaving the dock, a good captain must determine the "displacement" of the vessel. Displacement means how much water does the vessel push out of place, or displace. The weight of the water displaced will equal the weight of the boat. So you can find out how much your vessel weighs if you determine how much water it displaces when it settles into the water – i.e., measure how much of the vessel is under water. For example, if your vessel is 30 feet wide, 80 feet long and 4 feet deep in the water, the area of displacement is 30'x 80'x 4' = 9,600 cubic feet. One cubic foot of water weighs 62.4 lbs, thus your vessel weighs 9,600 x 62.4 = 599,040 lbs or 299.5 tons.

Using this method you also can determine how many one cent coins can be loaded into your aluminum foil vessel under ideal conditions. Obviously, you will want to convert the figures to inches and ounces. If you have some truly enthusiastic students who want to do the calculations for extra credit you could give them the weight of water for a cubic foot (62.4 lbs.) and see if they can figure out how to get the weight of a cubic inch. If they need some help, tell them there are 998.4 ounces (62.4 lbs. x 16 oz.) in a cubic foot of water and 1,728 cubic inches (12 x 12 x 12). Thus, a cubic inch of water weighs .578 oz. (998.4 oz. / 1,728 cu. in. = .578). The other figure you need is the weight of a Lincoln cent coin -- .11 ounces.

If the students still need assistance tell them to measure the watertight area that is created inside the aluminum foil vessel they have created. For example, if you have a 6" x 12" piece of foil and fold it in a square shape with 1" high sides you end up with a vessel that is approximately 4" wide x 10" long x 1" deep. In a perfect world the foil vessel would stay afloat until the weight of the vessel and its load equals the weight of the water that is displaced: 4" x 10" x 1" = 40 cubic inches x .578 oz. (the weight of one cubic inch of water) = 23.12 oz. If you divide this displacement weight of 23.12 oz. by the weight of a penny (.11 oz.) you discover that under absolutely perfect conditions the maximum number of pennies you could load before your vessel sinks is 210. In actual practice it would be virtually impossible to do this because you

most likely would not be able to distribute the load perfectly. Real vessels are required to have a substantial margin for error.

The Island Watershed Activity



Background
In order to understand many of the important water-related issues that society faces, students need to understand the existence and dynamics of watersheds (a.k.a. drainage basins). This will help them realize how an abandoned mine can cause the presence of dissolved metals in a stream many miles from the mine site, and how farming practices in the Midwest can contribute to a "dead zone" in the Gulf of Mexico. This activity will help students learn about the watersheds, giving them the foundation needed to understand these issues.

Materials
Modeling clay (about the size of a tennis ball), Eye dropper with water, 1 square food of wax paper, Graph paper (.5 cm x.5 cm squares or similar), Blue thread (~30 cm), Scissors, Red thread (~50 cm), Colored pencils

Learner Outcomes
1. Understand the relationship between topography and drainage.
2. Recognize that runoff from a certain area as the primary source for water in a stream.
3. Apply principles and terms associated with surface water systems, including watershed/drainage basin, upper, lower, divide, confluence, and tributary.

Procedures: To print a copy (pdf file) of the student worksheet, **CLICK HERE**.
1. Lay the wax paper on your table and then use the clay to build an island. The island should have at least 4 **distinct** drainage basins. The area of one of these basins should be at least twice as large as any of the others. It is best to avoid creating craters, cone-shaped peaks, and unrealistic landforms. Also, avoid islands that look like starfish. Consider putting the highest land somewhere away from the center of the island.

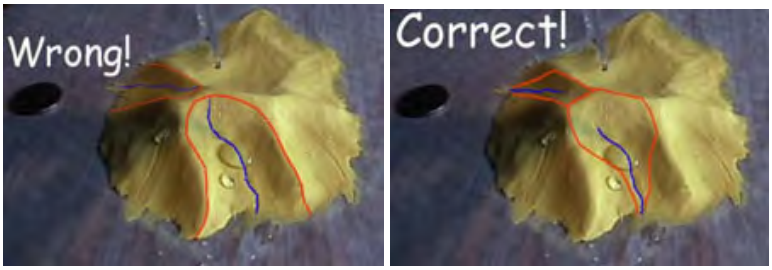
2. Use an eyedropper containing water to determine the approximate location of 4 (or more) of the island's largest rivers. Do this by gently dropping water from 3-6 cm above different locations on the island as shown below. Watch the path of the drops as they run off the island. If a drop gets "stuck", simply add more water to the drop. Eventually it should flow off the island. "Suck" the water up with the eye dropper after it runs off the island. You may reshape the island to get the rivers where you want them to be.

This activity was created by Rodney Benson, Email: rbenson@metnet.state.mt.us

3. Once you are satisfied with the drainage of the island, use pieces of blue thread to mark the location of the island's 4 (or more) major rivers. Press the thread gently into the clay to keep it in place. You will need scissors to cut the thread.

4. Next, use pieces of red thread to mark the boundaries of the watersheds of each river that you have identified (at least 4). **CLICK HERE** to see another example.

Here are some common mistakes:



Above: The image on the left shows three common mistakes. For one, rivers do not typically originate at the highest point in a watershed. Usually, the headwaters are some distance below that point as shown on the right.

Secondly, the divides are drawn incorrectly. They include more land (near the coast) than they should. The image on the right shows more realistic watershed boundaries.

Finally, in the image on the right, there is a gap between boundaries of the two basins. In reality, water at the top of that ridge will drain into one basin or the other, so a single line (divide) like that shown on the right would be correct.

5. Have your instructor check your island before going to the next step.

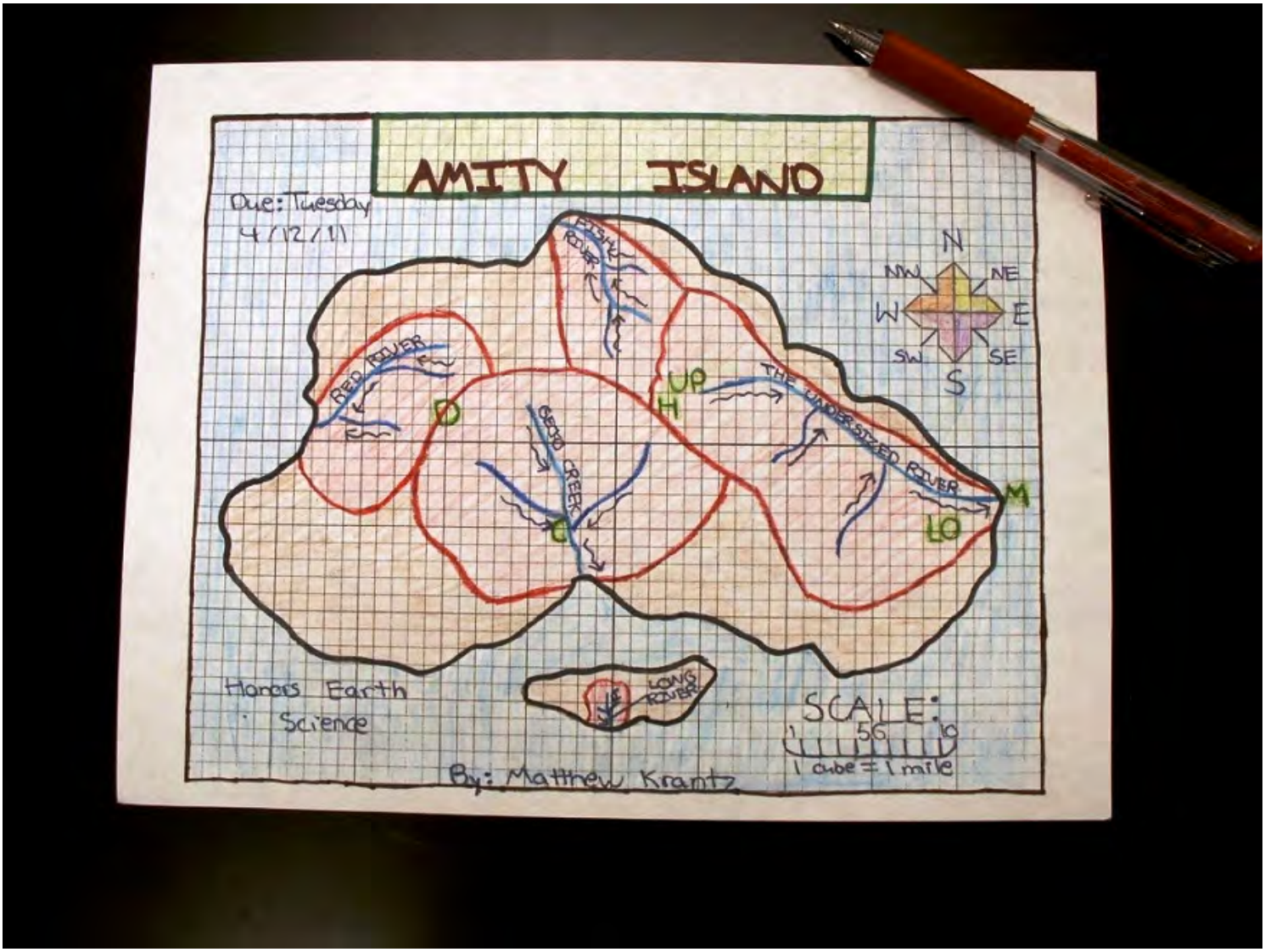
6. Lightly scratch the clay with the tip of a pencil to show the possible locations of 2-5 tributaries for each stream that you have identified with blue thread.

7. Next, make a map of your island. First, use scissors to cut along the shoreline of your island. Place the model onto a piece of graph paper, and then trace the edge of the island onto the paper. Set the model aside and draw each of the following onto the map: major rivers (blue), tributaries (blue), boundaries of drainage basins (red).

8. Do each of the following to your map:

a. Identify which direction will be "north". Position your map so that NORTH is a the top and then keep it in this position as you label it . . . so that the labels are all oriented the same way (right-side-up) as your teacher checks the map to determine your score.
b. Give your island a name. Place it at the top of the map.
c. Put arrows on all of the rivers (including tributaries) to show flow direction.
d. Name each of the major rivers (blue thread). Write these names along rivers.
e. Put a green **UP** in the upper part of each drainage basin.
f. Put a green **LO** in the lower part of each basin.
g. Put a green **M** at the mouth of your longest river.
h. Put a green **D** on one of the divides located on your map.
i. Put a green **C** at one of the confluences sown on your map.

j. Put a green **H** at the headwaters of your longest river.
k. Include a scale on your map. Have each side of the cubes on the graph paper be equal to 10 km of distance.



Here are some possible extension activities.

A. Imagine that there is a city near the mouth of the river that has the largest watershed that depends on this water for its people. Think of a potential problem in the upper part of this basin that threatens this water supply. On a separate sheet of paper, write a newspaper article (complete with title) describing the problem and explaining how it will impact the water supply for the city. (3-5 good paragraphs should do)

B. Obtain a piece of 12" x 18" construction paper. Draw and color a scene that shows a portion of one of the watersheds on your island. The scene should include the river and vegetation, as well as whatever else you envision present in the area.

C. Find a news article about an issue in your local (or regional watershed). Write a summary of the article and then come up with 5 "critical thinking questions" about the issue.

HOT LINKS

- The Watershed of the Yellowstone River
- Montana Earth Science Pictures of the Week
- Susquehanna River
- Delaware River

The Island Watershed Project (25 points) name: _____

<u>Put this handout in the IN Box at the end of each class period.</u>

Part A: Make the Island and determine the drainage pattern. (5 points)

1. Lay the wax paper on your table and then use the clay to build an island. Sculpt the island so that the maximum height is less than 2 inches.

a. The island should have at least four distinct drainage basins. Each basin (watershed) must share a divide with at least one other basin.

b. One basin should be at least twice as large as any of the other basins (watersheds).

c. Do not include any craters or caves on the island.

d. Avoid cone-shaped peaks and unrealistic features. Also, avoid having large flat areas. Consider putting the highest part of the island away from the center of the island.

2. **Take your time on this part. Be thorough!** Use a medicine dropper and little water in a cup to determine the probable location of the island's four largest rivers and their watersheds. Do this by gently dropping water from 1-2 inches above various parts of the island. Watch the path of the drops as they drain off the island.

a. If a drop gets stuck add more water to the drop. Eventually it should flow off the island. If it still doesn't move, reshape the area to increase its slope.

b. Use the dropper to suck the water up once it has drained onto the wax paper.

c. You may reshape the island to get the rivers where you want them to be.

Part B: Mark the major river and watershed boundaries. (10 points)

1. Once you are satisfied with the drainage of the island use pieces of blue thread to mark the location of the island's 4 major rivers. Press the thread gently into the clay to keep it in place. You will need scissors to cut the thread.

2. Use pieces of red thread to mark the boundaries of the watersheds for each river that you have identified (at least four). The watershed should include all the land that would drain into a particular river.

3. Have your instructor check your island before going on to the next step.

Teacher initials will go here: _____

Part C: Make a detailed map of your island. (10 points)

1. Use a pencil to lightly scratch the clay to show the possible locations of at least 2 tributaries for each stream that you have identified with blue thread. Reminder: RIVERS FLOW DOWNHILL!

2. Next, obtain a piece of graph paper make so that you can make a map of your island. Using scissors, cut along the coastline to remove the excess wax paper from the island. Center the island on the graph paper, and then trace its coastline onto the paper. Set the model aside and draw each of the following onto the map: major rivers (blue), tributaries (blue), and boundaries of drainage basins (red).

3. Do each of the following to your map. You will need a freshly sharpened green pencil.

a. Put an arrow on your map to indicate (and label) NORTH. Position your map so that NORTH is at the top and then keep it in this position as you label it . . . so that the labels are all oriented the same way (right-side-up) as your teacher checks the map to determine your score.

b. Put a tiny red triangle (▲) on the map to mark the highest elevation on your island.

c. Give your island a name. Place the name at the top of the map.

d. Put arrows on all of the rivers (including tributaries) to show flow direction.

e. Name the major rivers (blue thread). Write these names along the rivers.

f. Put a green "**UP**" somewhere in the upper portion of the largest drainage basin.

g. Put a green "**LO**" somewhere in the lower portion the largest basin.

h. Put a green "**M**" at the mouth of your longest river.

i. Put a green "**D**" on one of the divides located on your map.

j. Put a green "**C**" at one of the confluences shown on your map.

k. Put a green "**H**" at the headwaters of your longest river.

l. Include a scale on your map. Design the scale so that the length of one side of each square on the graph paper is equal to either 1 mile or 1 km.

Extra Credit: For up to 3 points extra credit, use colored pencils to make your island (and the surrounding water) look attractive.

Set your map and this handout in the designated area. Set your island on top of the two papers.

United States Environmental Protection Agency | Office of Water 4601 | EPA 810-F-98-004 June 1998

EPA ENVIRONMENTAL EDUCATION

NON-POINT SOURCE POLLUTION

GRADE LEVEL: 4 – 7

BACKGROUND: This activity is designed to demonstrate to students what an average storm drain collects during a rainfall event and how the water from storm drains can impact the water quality and aquatic environments of local streams, rivers, and bays.

MATERIALS NEEDED:

"Waterway"	"Pollutants"
Aquarium	Green Food Coloring (pesticides/fertilizer)
Rectangular Box	Vegetable Oil (motor oil)
Water	Soil/Sand/Pebbles (erosion)
Watering Can	Grass Clippings (or Shredded Paper) and Twigs
Spray Bottle	Cafeteria Waste and Trash

PREPARATION: Fill the aquarium half-way with water and place it on an accessible area where it can be easily viewed by the students. Cut a hole in the bottom of the box and place the box on top of the aquarium. The box represents the storm drain and the aquarium represents the waterway that the storm water mixes into after entering the storm drain. Leave the sides of the aquarium uncovered so that the students can view its contents.

PROCEDURE:

1. Introduce this activity with a discussion of storm drains and storm drain systems and their purposes. Discuss where the water and objects that float down into a storm drain go. Have students list all of the things that they can think of that might enter a storm drain during a rain storm.

2. Assign a group of students to each pollutant. Discuss each pollutant, including its use or origin and how it could enter the storm drain.

3. Have each group of students place their pollutant into the storm drain. Use the watering can to create rain to wash the pollutant into the waterway. While washing each pollutant into the waterway, review the pollutant and its use or origin. Discuss the following questions: How does the pollutant damage the environment? Do the people who are responsible for the pollutant want to damage the environment? Why did they do what they did? How can this type of pollution be stopped?

4. After adding all of the pollutants, examine the contents of the waterway. Discuss how the waterway has changed and how viewing this change makes the students feel.

FOLLOW-UP QUESTIONS:

1. What types of the pollution are natural?

2. What types of pollution are added by people living in the local communities?

3. How can we remove the pollution from the water?

4. What could be done to stop pollutants from entering storm drains?

VARIATIONS: Have the groups of students responsible for the pollution think of ways to remove the pollution from the aquarium. Try some of the removal methods. Which pollutants were easy to remove? Which were difficult to remove?

The EnviroScape

Objective: Student groups will conduct and evaluate results of two experiments to demonstrate (1) how water pollution happens and (2) how to prevent it.

Grade level/ time req't: K-12 options; one or more 20-45 minute sessions

Materials:
The "EnviroScape" is a watershed kit that includes all necessary parts and materials, including a detailed, easy-to-follow user's guide.

To obtain the EnviroScape ("Enviro II") contact:
- National Park Service at 651-293-8422 (Abby) or 651-293-8414 (Brian)
- Minnesota Valley National Wildlife Refuge Resource Librarian at 952-858-0731.
- Project WET (Minnesota DNR) at 651-259-5706.

It will be your responsibility to pick up and return the EnviroScape ***cleaned***, complete, organized, and undamaged! You may also need to supply own additional kool-aid or other "pollutants."

Introduction:
See EnviroScape User Guide, pp. 15-17, and 21, for setting the stage. Discuss the meaning of pollution, waterbodies, and watersheds; identify that everyone lives in a watershed and that we can prevent water pollution wherever we live. Discuss "point source" pollution and "nonpoint source (runoff) pollution" (information in User Guide.)

Summary of procedure (see User Guide for complete instructions):
1) Prepare the model (add buildings, trees, vehicles, etc.; put drain plug in water body.)
2) Introduce concepts of watersheds and water pollution.
3) Demonstrate "point" and "nonpoint" pollution, and observe results (User Guide, p. 12+).
4) Discuss what happens when it rains, storm drains (which drain directly to waterbodies), and home and neighborhood pollution sources.
5) Discuss ideas of how to prevent water pollution (User Guide, p.40+).
6) Demonstrate methods of pollution prevention, also called "Best Management Practices."
7) Discuss results.
8) Clean, dry and repack model (see User Guide instructions, p.63-64).

Evaluation:
Writing and drawing pictures about water pollution and how to prevent it are suggested.

MY STREET IS A RIVER:
AN URBAN WATERSHED MODEL

Minnesota Department of Natural Resources, Division of Parks and Trails
500 Lafayette Road - Saint Paul, Minnesota 55155-4052
(651) 259-5630 or 1(888) MINNDNR (646-6367)
www.dnr.state.mn.us/adoptriver

"This is one of the most difficult and most fun lessons to present. It is always a favorite with teachers as they know that their students will get the point… and it's messy" – Pauline Langsdorf, Metropolitan Council

SUBJECTS:
-Science, Social Studies, Language Arts
LEVEL:
-Grades 6 through 9
TIME:
-1-2 class periods, depending upon amount of pre-construction
MATERIALS:
-2' x 3' plastic rectangular box with lid
-plastic hose/tubing (5/8 inch diameter)
-9/16 inch fly-bit and electric drill (adults only)
-Styrofoam pieces (different sizes and thicknesses)
-Charcoal water filter (e.g. *Britta* filter, to be opened with a saw cut)
-food colorings
-nursery tree-bark wrap
-1' x 1' square of black nylon raincoat fabric (or other water-proof material)
-tree branch cuttings, or plastic foliage
-ground-up Styrofoam bits
-grass clippings
-foam plastic pipe insulation (split lengthwise for the street gutters)
-potting soil
- (optional) powdered potter's clay.
-tablespoon
-9 small glass jars
-scissors and knife
-plumber's putty
-toy cars
-watering can (or other sprinkling device)
-water
-paper towels (or newspaper)
-picture of different parking lots and urban areas
-2 transparent plastic (1-2 gallon size) jugs

OBJECTIVES

The student will do the following:

1. Assist the teacher, as appropriate, in developing a model which demonstrates how non-permeable areas collect a number of pollutants which can runoff into nearby lakes and streams.
2. Cite examples of urban water pollution sources by observing the model.
3. Suggest ways to reduce runoff in urban areas by redesigning and testing the model.

BACKGROUND INFORMATION

Rainwater running off roofs, lawns, streets, and parking lots can wash a number of water pollutants into lakes and streams. These pollutants include nutrients from garden fertilizers, bacteria from pet waste and rotting litter, sediments from erosion, toxic chemicals such as pesticides, oil, gasoline, and trace metals from emissions and grinding car parts (lead, mercury, and cadmium), zinc from roofs and gutters, and road salt or sand.

In developed areas, these pollutants usually collect on hard-surfaced parking lots and streets where they remain until a heavy rain washes them into nearby storm sewers. Sometimes these pollutants collect in such high concentrations that they kill fish when they are washed all at once into a steam. This is called "shock-loading". To prevent this from happening, urban planners are now planting grass filter strips, diversion ditches, and holding ponds to collect the runoff and allow it to seep slowly into the ground and/or to slow down the water so that less enters into storm sewers or washes into water bodies. A grass filter strip is an area of land planted with grass where water can flow instead of running directly into a storm drain. A diversion ditch is a channel lined with grass or riprap used to divert water away from an area. Diversion ditches divert water to open land or ponds where it can collect and be slowly absorbed into the ground.

APPLICATION

When you use this model you will get a great volume of dirty "storm-water" filling one of the two jugs in the model. The jug collecting ground-water will have much less flow or "shock-loading" and the water will be much cleaner. Even before the water is applied to your model, you will get some of the pollutants flowing into the storm-water container. This also simulates real-life sewer pollution. The conditions in this model illustrate urban storm-water systems in a way understandable to audiences of all ages.
Some studies have calculated that a landscape that is 15% impermeable, or paved over, will begin to show a significant

degrading of water quality. Most urban surfaces are closer to 70-80% paved/impermeable. You may want to discuss ways to solve the watershed problems you have observed. Consider collecting and showing color pictures of how these problems may have affected your own communities. Talk about the value of storm-drain stenciling, "Don't Pollute - Drains to River", "Drains to Lakes", etc.

ADVANCED PREPARATION

(NOTE: After checking my own home for the necessary supplies, it took me two hours of shopping to get the rest. I spent $30-40.00 to assemble the missing items. If a group pooled their efforts, this could perhaps be reduced. Assembly time is approximately two hours.)

I. Prepare the following mixtures in small glass jars and label as follows:
   a. ¼ cup (65 ml) water + 2 to 3 drops yellow food coloring + 2 to 3 drops green food coloring – label it "oil or gasoline".
   b. ½ cup (125 ml) water + 3 to 5 drops red food coloring – label it "trace metals".
   c. ½ cup (125 ml) water + 3 to 5 drops green food coloring – label it "fertilizers"
   d. ½ cup (125 ml) water + 3 to 5 drops yellow food coloring – label it "pet wastes and rotting litter."
   e. ½ cup (125 ml) water + potting soil – shake vigorously – label it "erosion". A nice alternative is to add powdered (or dissolved) potters clay. It has the advantage of not fermenting over time.
   f. ½ cup (125 ml) water + 5 drops blue food coloring – label it "toxic chemicals".
   g. ½ cup dry grass clippings (grind in a blender so they are small enough not to clog your model) – label it "grass clippings".
   h. 1/8 cup Styrofoam bits (Grind in blender NOTE: static cling may become a problem, add some water to prevent this) – label "Styrofoam bits".
   i. 1 tablespoon detergent in ½ cup water – label it "soap and detergent".

NOTE: If you decide to save the jars of "pollutants" for later use, remove the one with potting soil. In storage this one will create a putrefied mess. Make sure tub is thoroughly dried before storing with plastic cover.

PROCEDURE

I. Setting the stage.
   a. Explain that rainwater running of roofs, lawns, streets, industrial sites, and other non-permeable areas washes a number of pollutants into lakes and streams.

   b. Tell the students that hard-surfaced parking lots provide no place for rain to slowly filter through the soil, and pollutants transported in urban storm-sewer systems include nutrients, bacteria, litter, soil, toxic chemicals, organic materials and rubbish.

II. Building the model
   a. Drill two holes on the <u>bottom</u> of the plastic box as illustrated. Insert a hose in each hole to serve as a drain. *The plastic tubing should be one size larger than the fly-bit used to drill the holes into the bottom of the tub.*

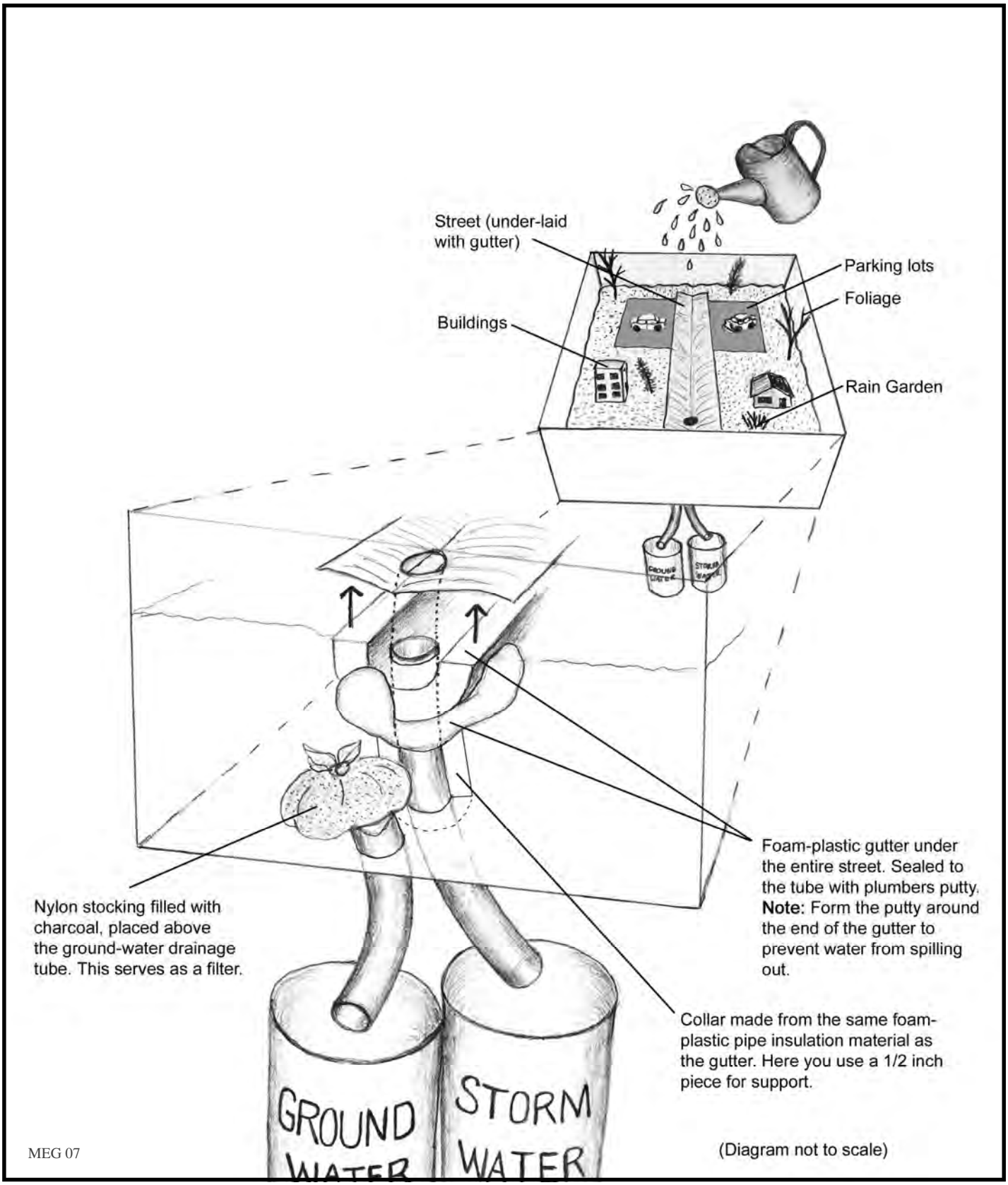
      - Before inserting the tubing, warm it up in a cup of boiling-hot water. It will then be flexible enough to force into the slightly undersized hole, making a leak-proof seal for the two drains; one leading to "street level" (storm-water) and the other draining to the very bottom of the tub (ground water).

   b. Place a nylon stocking filled with the charcoal contents of a water filter (e.g. Britta) over the "ground water" tube. This will simulate the filtration of the soil. (To get the charcoal out of the filter, carefully use a handsaw to crack open the filter).

   c. Use plumber's putty to seal the hose to the foam-plastic trough under the streets. This represents a city storm sewer. Explain to the students that water flowing through the hose will travel directly to nearby streams or lakes.

   d. Fill the tub 1/3 full with potting soil.

   e. The trough (or gutter) is to be placed under a street in the center of the tub, as illustrated. The trough is made from foam-plastic pipe insulation split length-wise, as illustrated, and should be placed about ½ inch above the bottom of the tub. It should be supported at the ½ inch level by a collar made of the foam-plastic, sealed with plumbers putty. The trough should be placed slightly below the top of the soil, so that surface water will collect in it, primarily water flowing UNDER the street. This is so it will form a natural street-drainage pattern when the tub is filled with potting soil. **Be sure that the trough is angled properly to receive virtually all of the "storm-water" which falls on the impermeable portions of the model.**


Street (under-laid with gutter)
Parking lots
Foliage
Buildings
Rain Garden
Nylon stocking filled with charcoal, placed above the ground-water drainage tube. This serves as a filter.
Foam-plastic gutter under the entire street. Sealed to the tube with plumbers putty. **Note:** Form the putty around the end of the gutter to prevent water from spilling out.
Collar made from the same foam-plastic pipe insulation material as the gutter. Here you use a 1/2 inch piece for support.
GROUND WATER
STORM WATER
MEG 07
(Diagram not to scale)

III. Urban landscape design and construction

a. Instruct the students to design their own urban environment by sketching a footprint of a road, parking lot, and buildings on a piece of paper.

b. Instruct the students to use Styrofoam or wooden blocks to represent buildings. Use raincoat material to lay out parking lots. The streets are made of nursery-tree wrap, folded length-wise, forming a slight "V"-shaped "paved" street. At one end of the "street", cut a circular hole to allow drainage to the "storm sewer" tube below it. Landscape the "non-paved" areas with plantings made from chopped foliage and twigs.

c. Once the students have competed the design, arrange a few *Matchbox* toy cars for a touch of realism.

IV. Bringing the model to "life"

a. When the students finish designing the urban area, instruct them to use tablespoons to deposit pollutants into the landscape. Use the pollutants prepared in the advanced-preparation section. The pollutants should be placed where they would occur normally. **Prop up the end opposite the drains in order to have the runoff drain towards the storm sewer and groundwater runoff drains.**

b. Place a large plastic jug under each hose to catch water coming out of the drains. Be sure to label the jugs "storm-water" and "ground-water". The tubes should hang over the edge of the table covered with newspaper or a towel. The receiving jugs should be placed on boxes high enough so that the tube actually enters the jug.

c. Create a heavy rainstorm using a sprinkling-type watering can. Keep raining until the pollutants wash off. Watch the water draining out of the storm drain. What does it look like? How did the runoff vary as you altered various elements of your model? Discuss why the "ground-water" drainage is so much cleaner than the "storm-water" drainage.

V. Follow-Up

a. How could the model be designed differently to reduce pollution? Discuss the important role of storm-water retention basins. What would happen if the water had not run off the model so quickly? What other things could be done to prevent urban pollution? Have the students redesign models with storm-water retention, rain gardens and less parking lot areas.

b. Compare the water collected from the storm-water jug to the sample from the ground-water jug. Discuss what was learned about keeping rivers and lakes cleaner, starting with the street in front of your house.

c. When the demonstration is complete, for easy transport, place the lid back on the tub and use duct tape to fasten a plastic bucket to the two drainage tubes. This will take care of the continued draining.

Credits: The world knows very few original ideas. The bulk of this watershed model design came from the Air & Waste Management Association, One Gateway Center, Third Floor, Pittsburgh, PA 15222. It was then modified by Pauline Langsdorf, Metropolitan Council Environmental Services, 230 E. 5th St., St. Paul MN 55101. It was further modified by Paul Nordell and Kelly Barthol at the Minnesota Department of Natural Resources, Adopt-a-River Program, 2/2/99. The last modification was done by Paul Nordell and Megan Godbold, Minnesota Department of Natural Resources, Adopt-a-River Program, 3/6/2007.

Downloads

- Adopt a River Brochure PDF
- Adopt-a-River Fun book: Environmental Education Activities for Grades 2-5 (2MB) PDF

Adopt a River's Virtual Watershed for Educators

- Virtual Watershed Information Brochure (read this first!) PDF
- Virtual Watershed Video (.avi file, 15.5 MB)
- Virtual Watershed Powerpoint Presentation (25 MB)
- Virtual Watershed Powerpoint accompanying Jeopardy template (1.1 MB)

"Life Span of Litter:" Game for Educators

- Game Instructions PDF
- Student Worksheet PDF
- Life Span of Litter chart PDF
- Object Cards PDF

Adopt a River Clipart Gallery

Adopt a River Podcasts

- "Trash Art from River Cleanup"

2.
Thematic Classroom Activities

Big River Journey
Mississippi River classroom activities
and educational resources

Big River Journey Classroom Activity: Geography

Map the Mississippi Watershed!

Instructions for students:
Use the map template "The Mississippi River and Watershed" and other resources to complete the following. Use another sheet for your answers.

1. On the lower right corner of your map place an arrow that indicates which direction is north on the map. Put a capitol "N" at the tip of the arrow. Add the letters S, E & W around the arrow to indicate the directions south, east and west.
2. Using a light green pencil, carefully outline the Mississippi Watershed on your map by following the dashed lines. Write "watershed boundary" neatly along this line.
3. Using a light blue pencil, carefully highlight the Mississippi River; neatly label it.
4. Where does the Mississippi River begin? Mark that place with a blue dot.
5. Place a red dot on your map where the Twin Cities are located.
6. Highlight the Minnesota River with a light yellow pencil, highlight the Missouri River with light brown, and the Ohio River in orange. Label each river.
7. Using other colors, neatly highlight at least two other rivers on the map that are tributaries to the Mississippi; label each river.
8. At what city does the Missouri River meet the Mississippi River? Mark that place with a pink dot on your map.
9. Make a "key" on your map to indicate what each colored line or dot represents.
10. Lay a string along the river, following all the river's curves; cut or mark the string to the length of the river. Use the scale of miles at the bottom of the map to find the approximate length of the Mississippi River.
11. Generally, which direction does the Mississippi flow?
12. Label the body of water that the Mississippi River flows into on your map.
13. What tributary (stream or river) of the Mississippi River is your school closest to?
14. Name the states that have land along the Mississippi River. Write their two-letter postal code abbreviations (like "MN") on each of those states on the map.
15. Use a pencil to darken the state boundary lines inside the Mississippi Watershed area. How many states do you count that contribute water into the Mississippi River?
16. Two Canadian provinces drain water into the Mississippi River. What are the names of these provinces?

Map the Mississippi Watershed!
Teacher Notes:

2. The Mississippi *Watershed* is all the land area that drains into the Mississippi River. On the map the watershed (or "basin") boundary is indicated by the dashed line that encircles all Mississippi River tributaries.

4. By definition the Mississippi River starts at Lake Itasca in northern Minnesota. However, it can also be said that the Mississippi River starts wherever rain or snow falls in the Mississippi Watershed, because water that flows from land anywhere in the watershed will eventually flow into the Mississippi River. (This is a good point for discussion.)

8. St. Louis

10. The length of the Mississippi River is approximately 2,350 miles. Student estimates will tend to be low using this method of measurement because it is impossible for them to follow all the river's curves, many of which do not show up on this scale of map.

11. southward

12. Gulf of Mexico

13. Answers will vary with the school. Find the stream or river closest to your school that flows to the Mississippi River. Tell students that water running in your street flows to the river or a tributary of the river, too! In the Twin Cities area, all surface water flows to the Mississippi River.

14. Ten states border or include the Mississippi. They are: Minnesota (MN), Wisconsin (WI), Iowa (IA), Illinois (IL), Missouri (MO), Kentucky (KY), Tennessee (TN), Arkansas (AR), Mississippi (MS), Louisiana (LA).

15. There are 31 states whose waters drain to the Mississippi. From this map, it is difficult to count them all.
The 31 states are: Alabama, Arkansas, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Tennessee, Virginia, West Virginia, Wyoming, Wisconsin

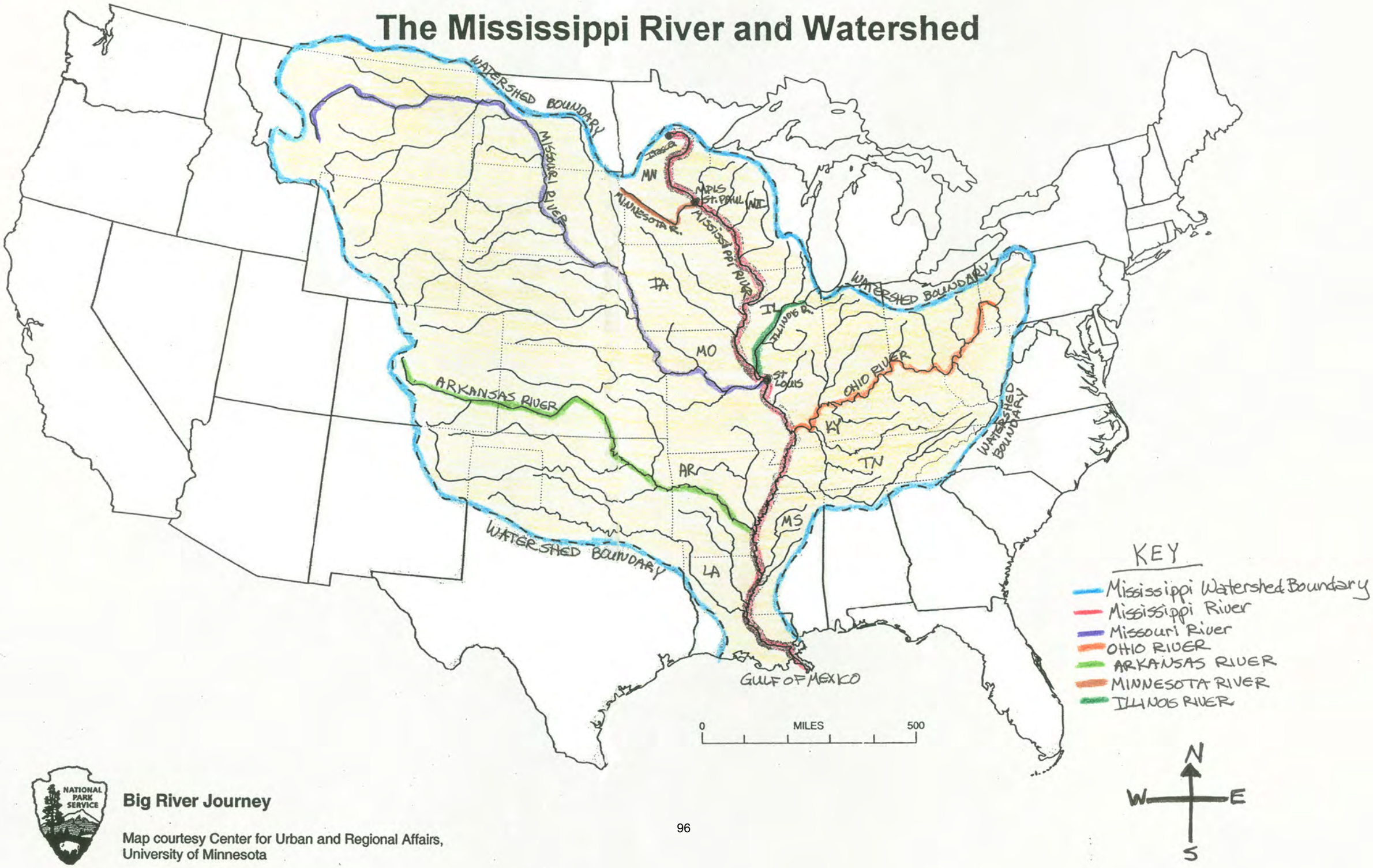
16. Alberta and Saskatchewan

The Mississippi River and Watershed

Big River Journey

Map courtesy Center for Urban and Regional Affairs,
University of Minnesota

The Mississippi River and Watershed



NATIONAL PARK SERVICE

Big River Journey

Map courtesy Center for Urban and Regional Affairs,
University of Minnesota

Map the River in the Twin Cities!

Instructions for students:
Use the map template "Mississippi River: Minneapolis/St. Paul, Minnesota" and other maps and resources (including National Park Service brochure) to create your own map of the Mississippi River in the Twin Cities.

1. Complete the compass rose beneath the map title by writing "N" for north, "S" for south, "E" for east, and "W" for west. And in the lower part of the page, draw a line with division marks to create a "scale of miles," ensuring that the scale can be used to measure distances on the map.

2. Use city maps to locate where the Interstate 94 and Interstate 35E highways cross the river, and draw the bridges onto your map.

3. Locate and draw the Hennepin Ave. bridge, Lake St. bridge, Smith Ave. "High Bridge," and the Highway 52 ("Lafayette") bridge on your map.

4. Locate and label downtown Minneapolis and downtown St. Paul on your map.

5. Indicate the location of Historic Fort Snelling with an orange star, and label it.

6. Locate and label the Minnesota River and Minnehaha Creek on your map. Draw a line across Minnehaha Creek where Minnehaha Falls is, and label it.

7. Locate and label Nicollet Island and Pike Island. Color them light green.

8. Locate and draw in St. Anthony Falls; label it. Draw a line across the river where Lock and Dam #1 ("Ford Dam") is located; label it.

9. Use a National Park Service map (or others) to find "river miles"; indicate them on your map. "River miles" indicate number of miles upstream from the Ohio River; on your map these numbers should be from 835 to 855, and may be indicated for every 5 miles.

10. If your school and/or your home can be located on the map, mark them with a red star (school) and a blue star (home), and label them "school" and "home."

11. Use a map of Mississippi River canoe routes to locate boat access locations and canoe campsites. Mark them on your map.

12. Locate at least four more historic or modern river features and label them on your map. Some possibilities include Mounds Park, Fountain Cave, Carver Cave, Kaposia, Crosby Lake, Pickerel Lake, Fort Snelling State Park, Minnehaha Park, Boom Island Park, Hidden Falls Park, railroad bridges, historic mills, etc.

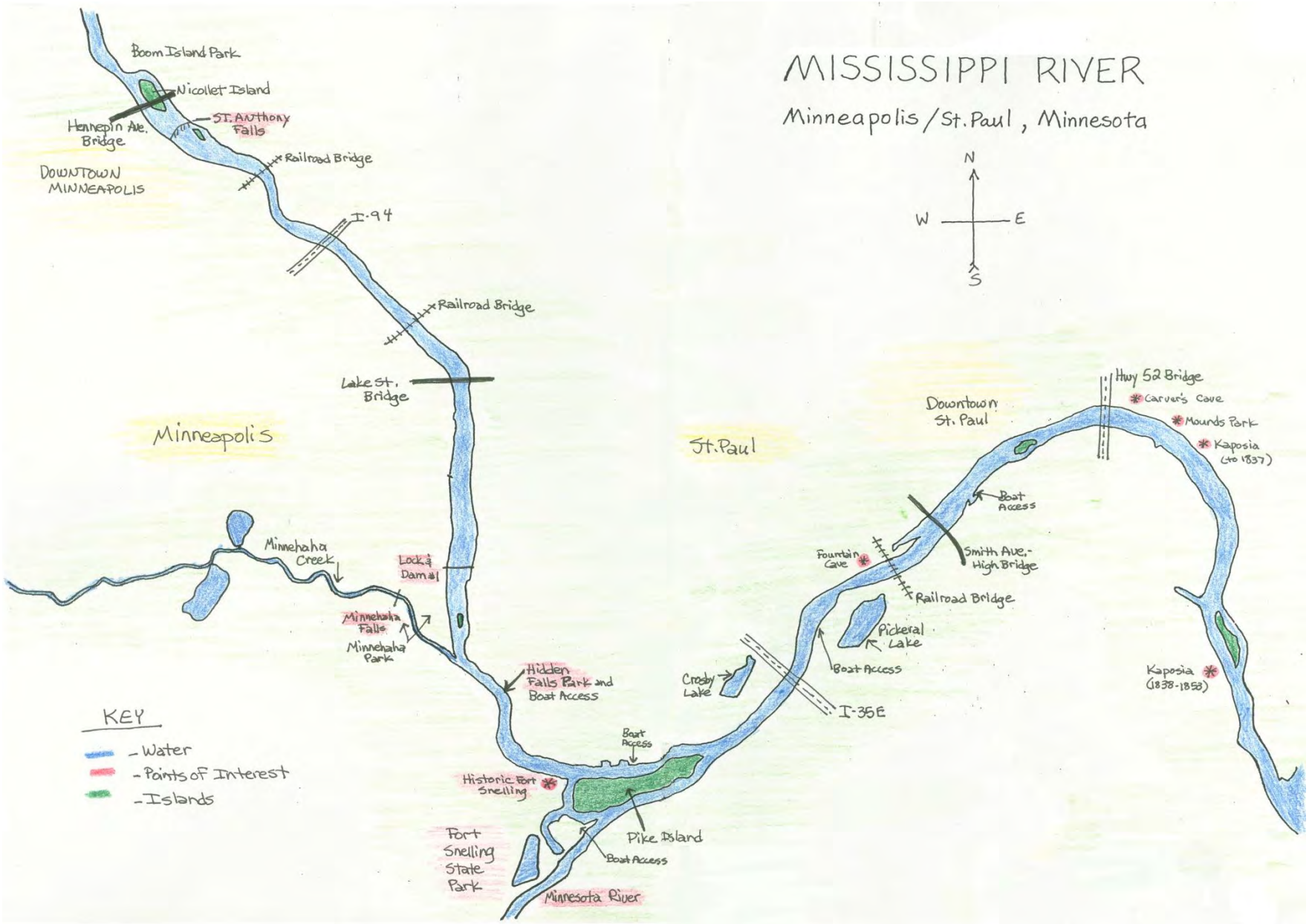
13. Color the rivers, lakes and streams light blue. Lightly color land areas as desired.

Mississippi National River and Recreation Area

Map the Mississippi River in the Twin Cities

Mississippi National River and Recreation Area

Map the Mississippi River in the Twin Cities



Lessons in a Landscape:

Our Place on the Mississippi River

Objective: Students will explore local river or neighborhood areas to find answers to questions about the river, the landscape, and local history.

Grade level/ time req't: 3-8; 1 hour for outdoor hike, preceded by 20-minute, whole-class preparatory session, and post-hike session(s) for writing or further investigations

Procedure: Select from the following questions, and add your own questions about the local landscape. Take a group hike (after or during a rain is best) and use other resources to find answers to these questions. After the hike, write what you found, and write additional questions that you'd like to answer. Make a simple map to show local landscape features such as creeks, and how rain flows from your school to the river.

Questions about the river and landscape:

1. Where does water come from and go to when it flows over this land?
2. Where does water go from streets, sidewalks, playgrounds and parking lots?
3. Does rain soak into the ground or run over it? What % of surface area is permeable?
4. How does rain get to the river from here?
5. Does rain flow quickly or slowly to the river? What does the rainwater carry with it?
6. How has this land been shaped by water? Is the river valley steep or shallow? Why? (What other landscapes have been shaped by water? Where are they?)
7. Do you think the land around us is changing today? How/why?
8. What cultures of people have lived here before us? What evidence have they left? How did they use and affect the river?
9. How has the river affected human settlement patterns?
10. How are people using the river and the land around it today? What animals use it?
11. What does the river (or a tributary) look like? Smell like? Is it clear or cloudy?
12. How has the river been changed or affected by people? Are there any dams, storm drain pipes, or dredging? How have these changed the river? Is the river drinkable?
13. Do you find evidence or sources of pollution? What effects does the pollution have?

Teacher Background:

Landscapes tell stories. The Mississippi River and watershed is the central feature of our physical and cultural geography in the Midwest. The river's landscape is a history book and a science book at the same time. You can explore this landscape and "read" stories about science and change, geology and hydrology, cultures and settlement, ecology and the connectedness of all things. The river and its surrounding landscape offers a tangible way to investigate our history, science, and sense of place. Walking lessons can involve inquiry (as suggested by questions above), or could be an environmental inventory (simply observe and record what you see.) An inventory could become the basis for stewardship action.

Words/ science concepts: environment, erosion, floodplain, geology, hydrology, landscape, pollution, runoff, sediment, storm drains, tributary, watershed

Connecting lessons: geography, mapping, local cultures and history, geology, time, water pollution, service learning (stewardship), art (drawing, model building)

Educator's Classroom Activity Book

Teacher's Guide

Prepare Your Students for a Visit to Historic Fort Snelling

HISTORIC
FORT SNELLING
Minnesota Historical Society

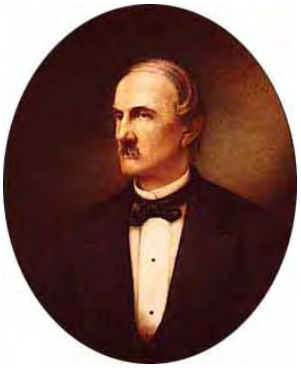
Lesson 1 - Early Minnesota & the Fur Trade

Archeologists believe the first humans entered this region between 12,000 and 9 000 years ago. These people used the waterways for transportation, food, and to develop an extensive trade relationship with other native peoples. Trade items have been found along the entire Mississippi River. When the first Europeans arrived in the mid-1600s, the largest groups of American Indians living in the region that would become Minnesota were the Ojibwe and t he Dakota. The Ojibwe primarily lived in the heavily wooded areas in the northern part of the region, while the Dakota called the prairies to the south home.

***Wa-ba-sha*, a Dakota Village**
(Painting by Seth Eastman)

Ojibwe Canoe
(Painting by Eastman Johnson)

The first Europeans who arrived in the Upper Mississippi were French traders looking to exploit the region's abundant resources of fur-bearing animals. A fashion craze for fur felt hats in Europe led to a boom in the fur industry, and Europeans eagerly crossed the Atlantic in search of a greater supply of fur. First French, and l ater British, traders established friendly trading relationships between themselves and the American Indians they encountered. Many traders were welcomed into the tribes as family members (some even married Indian women, thereby strengthening their ties). T hrough these kinship relationships, traders and Indians benefited materially from each other; Indian trappers exchanged the furs they harvested for the goods the trader offered. The trappers and traders utilized waterways to transport furs and trade goods by canoe, first to the trading post, then to the east coast for processing.



Henry H. Sibley

The American Fur Company (AFC) was founded in 1808 by John Jacob Astor. The greatest competition to the company came from British and Canadian companies, such as the Hudson's Bay Company and t he North West Company, but by the late 1820s the US government outlawed non-American trading companies within its borders, allowing the AFC to dominate the American fur trade. In 1834 Henry Hastings Sibley joined the company as regional manager for the Northwest Territory, making his headquarters in Mendota - across the river from Fort Snelling.

Read the previous page, *Early Minnesota and the Fur Trade*, carefully and answer the following questions.

1. When do archeologists believe the first humans lived in the region that would one day become Minnesota?

Between 9,000 and 12,000 years ago

2. Who called this area home before Europeans arrived, and where did they live?

Ojibwe - northern woods/forests
Dakota - southern plains

3. How did the Dakota and Ojibwe use the rivers and waterways of the Upper Mississippi Valley?

Transportation, food, trade

4. What first brought Europeans to the region?

European traders were looking for fur-bearing animals for the fur trade

5. How did European traders during the 1600s and 1700s interact with the Dakota and Ojibwe people in the region?

They maintained friendly trading relationships with Indians - some even married into the tribes. Traders provided the Indians with trade goods in exchange for the furs they trapped.

6. How were the rivers and waterways of the Upper Mississippi Valley used during this time period?

They used them to transport furs and trade goods by canoe - first to trading posts throughout the territory, and then to the east coast for processing and sale.

7. What was the name of the main American fur trading organization in the 1800s? Who was its representative in this region?

The American Fur Company - Henry Hastings Sibley

8. Name two competitors to America's fur trade interests in the early 1800s.

Hudson's Bay Company & North West Company

Lesson 2 - Trade Goods

Imagine that you are a fur trapper for the American Fur Company and about to set out for the winter to trap furs. Below are items you needed to buy on credit from the trader when you signed up to be a trapper, and a value key for the different kinds of fur you would need to collect. During the 1820s and 1830s, the currency of the fur trade was the muskrat and all items, from furs to guns, were valued in muskrats or "rats." Using your math skills, answer the questions below each of the trade goods you have purchased on credit. Feel free to use the back of this sheet to solve the math problems.

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1 knife = 4 muskrats
1 fire steel = 6 muskrats
5 measures/gunpowder = 50 muskrats
1 kettle = 31 muskrats
1 axe = 20 muskrats

1 Brass Kettle = $5.00

3 fire steels = $2.88

1 axe head = $3.20

How many rats is this kettle worth?
31.25 muskrats

_____

If you had one bear skin and one beaver skin, could you afford to buy the kettle?
Yes

_____

How much does 1 fire steel cost in dollars?
$0.96

_____

How much does a fire steel cost in rats?
6 muskrats

_____

How many fire steels could you buy if you had 3 deer skins and 1 buffalo skin?
4 fire steels

_____

How many axe heads would you need to trade for a trade gun?
6 axe heads

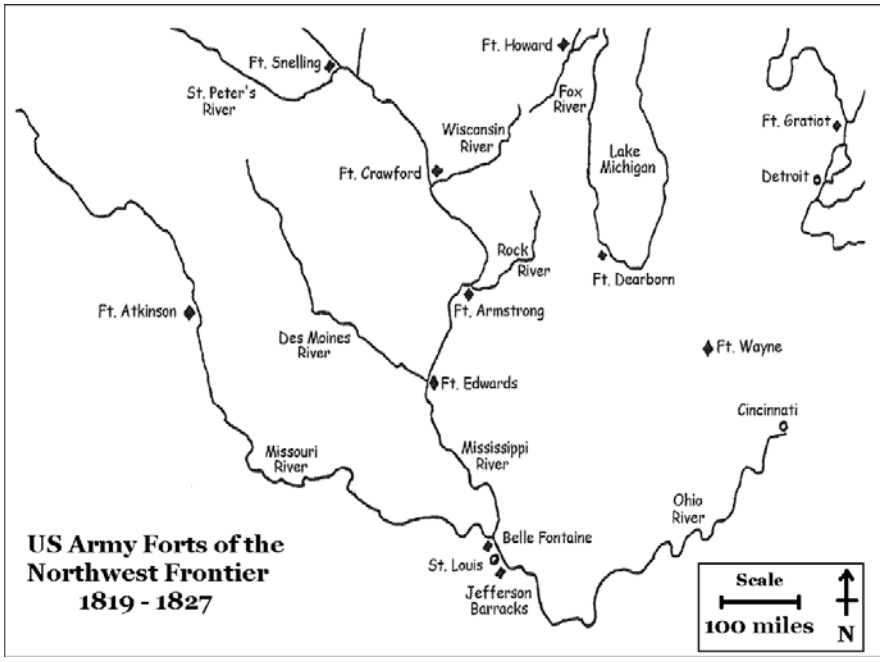
Lesson 3 - U.S. Expansion into the Northwest Territory

After the Revolutionary War (1775-1783) the United States began a series of expansionist actions in order to acquire more territory to the west. In 1803, President Thomas Jefferson made a historic purchase when he acquired approximately 828,800 square miles of land from France for a cost of $15 million - known as the Louisiana Purchase. Overnight the United States doubled in size, and Americans were excited by the prospect of expanding the nation's borders from the Atlantic to the Pacific and eager to explore the new territories.

Lt. Zebulon Pike

In 1804 Jefferson sent the famous explorers Meriwether Lewis and William Clark to explore along the Missouri River all the way to the west coast. The following year Zebulon Pike was charged by General James Wilkinson to find the source of the Mississippi River. With several boats filled with supplies and soldiers, Pike travelled up the Mississippi valley to the junction of the Mississippi and Minnesota Rivers. There, he made an unauthorized treaty with local Dakota people for the rights to set up a permanent fort at the confluence of the rivers

The US government wanted to establish firm control of the region in order to neutralize British influence from Canada. To do this the army built several forts along important rivers and waterways to control trade and encourage positive relationship with the American Indians in the region. The map shows the locations of the forts built between 1819 and 1827. In 1814, future President Zachary Taylor established Fort Edwards at the junction of the Mississippi and Ohio Rivers.



Construction began on Fort Armstrong (at the Mississippi/Rock River junction) the next year, and Fort Crawford was established where the Wisconsin and Mississippi Rivers met in 1816. The largest of all was Fort Snelling, built on the land purchased by Pike in 1805. Lieutenant Colonel Henry Leavenworth arrived at the junction of the St. Peter's and Mississippi Rivers with a detachment of soldiers from the 5th US Infantry in 1819, and construction began on the fort in earnest the following year.

Read the previous page, *U.S. Expansion into the Northwest Territory*, carefully and answer the following questions.

1. How large was the Louisiana Purchase and how much did it cost the United States?

828,800 square miles - $15 million

2. What were the names of the explorers sent out by President Jefferson in 1804 and what was their mission?

Meriwether Lewis and William Clark; explore along the Missouri River

3. What was the name of the Army explorer sent by General Wilkinson and what was his mission?

Zebulon Pike - find the source of the Mississippi River

4. Look at the map. What are the rivers a party of explorers would need to follow to get from Cincinnati to Fort Snelling? Name the cities and forts the explorers would pass along the way.

Ohio and Mississippi Rivers

Cities: St. Louis

Forts: Jefferson Barracks, Belle Fontaine, Ft. Edwards, Ft. Armstrong, Ft. Crawford

5. Write the names and dates of establishment of the forts along the Mississippi River north of St. Louis.

Fort Edwards - 1814 ; Fort Armstrong - 1815

Fort Crawford - 1816 ; Fort Snelling - 1819

6. Using the map scale, estimate the distance from St. Louis to Fort Snelling.

Between 700 and 720 miles

7. What were two reasons the army wanted to establish forts in the Northwest Territory?

1. **To establish firm control of the region by neutralizing British influence from Canada.**
2. **To control trade and encourage positive relations with American Indian tribes in the region.**

Interactive Supplement - How Big Was That?

Learning Objectives:

Students will simulate the living spaces of soldiers at Fort Snelling in the early 1820s with their own today. Students will be challenged to compare and contrast the notion personal space in the early 19th century with today and discuss the implications of this on daily life during this historical period.

Grade Level:

4th – 6th

Time:

Approximately 20 – 30 minutes

Materials:

Yard stick or Tape Measure
Tape (masking works well)
Large empty room to tape off spaces
Writing paper
Pencils or pens

Introduction:

During the 1820s, the soldiers at Fort Snelling lived in squad rooms in the barrack buildings. These rooms were 17 feet by 15 feet and each held one squad, a total of twelve men per room. Soldiers spent relatively little time in these rooms, since the majority of their time was spent outside working in fatigue details or drilling on the parade ground. Each room had 6 bunk beds, each bed measuring 3 feet wide by 6 feet long and two soldiers were expected to share each bunk.

These rooms seem cramped to us today, but they would likely have been considered quite comfortable by most of the soldiers in the 1820s. Ideas about privacy and personal space were different in the 1800s than they are today. It was common for more than one person to share a bed, especially travelers who rented bed space as opposed to rooms like they do today.

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Conclusions and Follow Up:

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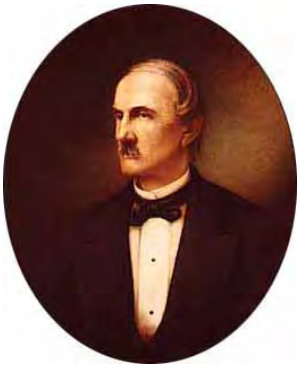

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_____

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Lesson 3 - U.S. Expansion into the Northwest Territory

After the Revolutionary War (1775-1783) the United States began a series of expansionist actions in order to acquire more territory to the west. In 1803, President Thomas Jefferson made a historic purchase when he acquired approximately 828,800 square miles of land from France for a cost of $15 million - known as the Louisiana Purchase. Overnight the United States doubled in size, and Americans were excited by the prospect of expanding the nation's borders from the Atlantic to the Pacific and eager to explore the new territories.

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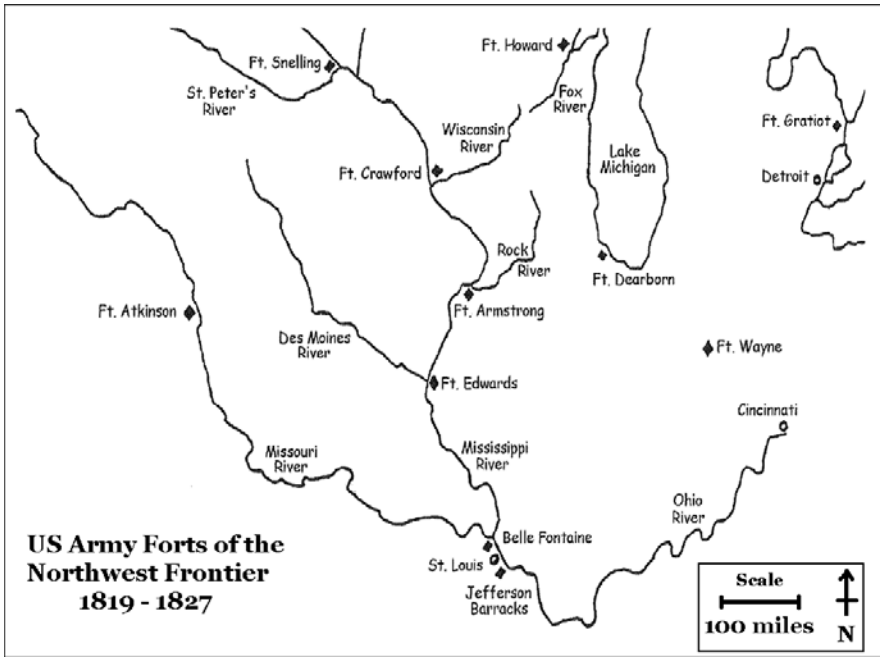

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1. How large was the Louisiana Purchase and how much did it cost the United States?

2. What were the names of the explorers sent out by President Jefferson in 1804 and what was their mission?

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4. Look at the map. What are the rivers a party of explorers would need to follow to get from Cincinnati to Fort Snelling? Name the cities and forts the explorers would pass along the way.

5. Write the names and dates of establishment of the forts along the Mississippi River north of St. Louis.

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Surf the Mississippi

Instructions for students: Visit the following websites and answer the following questions.

A. Explore Historic Fort Snelling Virtual Tour at:

http://www.historicfortsnelling.org/plan-visit/what-do

1. The confluence of what two rivers is shown on the diagram?
2. Why do you think the fort was built at this location? (Click on "History" in the top banner for more information.)
3. Explore any two of the eighteen features on the diagram (using the hot links.)
    1) Describe the two features, and what they were used for.
    2) Why were these features important to the fort?

B. Explore St. Anthony Falls at:

http://www.mvp.usace.army.mil

First click on "History," then *"Historical Publications",* then *"Engineering the Falls."*

1. Click on the diagram of the falls to enlarge it. What is the main idea shown by the diagram?
2. Read the first paragraph in the "Overview" section, then name four values or uses that people have had for St. Anthony Falls.
3. Scroll down to the part about "Geology."
    1) 12,000 years ago a huge waterfall over 175 feet tall existed near what present-day place?
    2) From its origins near _____, St. Anthony Falls retreated slowly upstream at about _____ feet per year until it reached its present location.
    3) Geologists estimate that the waterfall was originally about _____ feet high, but by the early 19th century, explorers described it as only about _____ feet high.

C. Explore historical river vessels (boats) at:

http://www.mnhs.org/

Type in "Mississippi River vessel types," Then click on "Search."
Find and click on "Vessel Types on Minnesota's Inland Waters."

1. Name three ways of powering a vessel on the Mississippi River without fuel.
2. Describe a flatboat. How was it propelled and steered? What were its uses?

D. Optional: Explore other river-related web sites:

1. http://cgee.hamline.edu/UWC/UWC-MN/ (Urban Water Cycle interactive)
2. http://cgee.hamline.edu/Mississippi-Life&Death/ (Mississippi River pollution)
3. http://www.bellmuseum.umn.edu/games/watershed (watershed game for kids)
4. http://www.epa.gov/owow/nps/kids/ (aquatic bug theater, kids' water activities)
5. http://water.epa.gov/learn/kids/drinkingwater/index.cfm (water activities, art and experiments)
6. http://ga.water.usgs.gov/edu/earthrivers.html (earth's water, water science)
7. http://www.nps.gov/miss/ (Mississippi National River & Recreation Area)

Teachers' notes re: "Surf the Mississippi"

A.1. The diagram shows the confluence, or meeting place, of the Minnesota and Mississippi Rivers.

A.2. (Answers will vary.) The fort was strategically built at this location because the river confluence was a key intersection for transportation at that time and a center for fur trade. This location allowed U.S. Army soldiers to control traffic on the two key rivers of the area. (For more information, click on "Fort Snelling History" and then "An Outpost in the Wilderness.")

A.3. (Answers will vary with the feature being described. Explore web site for information.)

B.1. The diagram shows the recession, or erosion, of the waterfall from 1660 to 1887.

B.2. The falls have been valued for religious significance, a landmark, geological interest, scenic beauty, water power, and navigation.

B.3. 1) 12,000 years ago the predecessor of St. Anthony Falls was located near downtown St. Paul. (It is referred to as River Warren Falls.)

B.3. 2) what is now Ft. Snelling; four

B.3. 3) 180; 16-20

C. The exact web site location is...
http://www.mnhs.org/places/nationalregister/shipwrecks/mpdf/incraft.html

C.1. Ways to power vessels on the Mississippi River without fuel include: wind, water, hand (human power or paddle), and horse. (Indicated in first subtitle of this web site.)

C.2. Flatboats are strong, box-like boats with flat bottoms, perpendicular sides, and upturned ends. They sometimes were covered throughout their entire length. They were constructed to float with the current (they were water-powered) and were steered by large oars or sweeps placed at the ends. Most flatboats never returned after descending the river; often, they were dismantled and used or sold for lumber at their downstream destination.

The River is a Poem

Instructions for students: Use the following poetry forms and examples to help you write your own river poem.

Rules for Cinquain poetry:
Line 1: Title in 2 syllables (or words)
Line 2: Description of the title in 4 syllables (or words)
Line 3: Description of action in 6 syllables (or words)
Line 4: Description of a feeling in 8 syllables (or words)
Line 5: Another word for the title in 2 syllables (or words)

Example:

river
water, wildlife
flowing, rippling, flooding
with grace and strength it rolls to sea
life source

Rules for Diamonte (diamond shaped) poetry:
Line 1: Noun
Line 2: Adjective, Adjective
Line 3: Participle, Participle, Participle
Line 4: Noun, Noun, Noun, Noun
Line 5: Participle, Participle, Participle
Line 6: Adjective, Adjective
Line 7: Noun

Example:

Ecosystem
Large, Complex
Producing, Consuming, Decomposing
Vegetation, Wildlife, Habitat, Niche
Competing, Preying, Interacting
Connected, Universal
Community

Rules for Haiku poetry:
Line 1: 5 syllables
Line 2: 7 syllables
Line 3: 5 syllables

Example:

The snake eats the mouse
Energy, nutrient flow
Will sustain wildlife

Rules for Free Verse poetry:
There are no rules of form or rhyme in free verse poetry.

Big River Art Contest 2013

The annual Big River Art Contest engages students in the science, heritage and stewardship of the Mississippi River through art.

Open to: All students, grades 4-6

Categories (choose one themes for the subject of your art)**:**

1) The Mighty Mississippi
2) Caring For the River
3) Big River Journey*
4) Journey to the Falls**

** Must have been on a Big River Journey trip*

***Must have been on a Journey to the Falls trip.*

How to enter:

All entries must be original, on **11" x 17" paper**, flat, and signed. Work may be created using pencil, pen, markers, pastels, crayon, watercolor, paint, or flat collage. Original poetry may be included in the artwork for example a stewardship message in category 2 ("Caring for the River.") Each student may submit one work of art. Student's name, home address and phone #, school name, grade, phone #, and teacher's name must be clearly printed on the back of the artwork, along with name of the chosen category theme. Students may instead fill in the entry form template and attach it securely to the back of the artwork. **Entries must be received by 4:00 p.m., Tuesday, June 4, 2013**. Submit school packets of entries to: *Art Contest, Mississippi National River and Recreation Area, 111 E. Kellogg Blvd., Suite 105, St. Paul, MN 55101-1256.*

Prizes: In each category a grand prize winner and three winners will be chosen.
Student prizes: For categories 1, 2 and 3 each winner will receive two tickets for a boat ride on one of the Padelford boats and two tickets to the Science Museum of Minnesota (including Omni Theater). For category 4 each winner will receive two tickets for a regular site seeing cruise on the Minneapolis Queen Riverboat and two tickets to the Mill City Museum (MHS). In addition to these prizes, the grand prize winner in each category will receive an additional prize.
Teacher prizes: For categories 1, 2 and 3 one grand prize winner teacher will receive a free trip (which may be Big River Journey.) The other two grand prize winner teachers each receive a free trip (*not* Big River Journey.) Each trip is for up to 30 students on a Padelford Packet Boat Co. boat during the 2012-13 school year. For category 4 the grand prize winning teacher will receive two tickets for a Sunday Brunch cruise on the Minneapolis Queen Riverboat.

Judging criteria and selection of winners:

Works of art will be selected by a panel of judges who will evaluate works on artistic merit, content (including relevance to chosen theme), and *originality*. Winners will be notified by mail or phone; prize tickets will be mailed to the home address of each winning student.

Additional information and display of winners' art:

All works of art submitted shall become the property of the Mississippi National River and Recreation Area (National Park Service.) No works will be returned. Winning art may be displayed at the Science Museum of Minnesota, Fort Snelling State Park Visitor Center, Mill City Museum, and/or other venues. The winning art will be featured on the website of the Mississippi National River and Recreation Area (http://www.nps.gov/miss/).

Sponsors: Mississippi National River & Recreation Area (NPS), Padelford Packet Boat Co., Science Museum of Minnesota, Minneapolis Queen Riverboat, Big River Journey and Journey to the Falls Partners

Further information: Kathy Swenson, 651-293-8424

Big River Art Contest 2013 - Ideas to get you started:

1) **The Mighty Mississippi-** This category is about the Mississippi River – its wildlife, plant life, scenery and recreation – and its relationship to you.
   - Exploring the river with friends, canoeing, fishing, hiking, biking, etc.
   - The river as a home for animals - turtles, frogs, mussels, beaver, otter, fox, deer, raccoon, etc. (Add a poem about the animal!)
   - Birds and bird watching or the Mississippi River as a flyway
   - Fish and fishing (portray specific species like catfish, paddlefish, or sturgeon)
   - Aquatic insects (idea: show how aquatic insects are part of a food chain)
   - Following animal tracks

2) **Caring For the River-** Here are some ideas:
   - Drink water? Then help care for the river! It's our water source!
   - Your street flows to the river!
   - Be a friend of the Mississippi River!
   - Do you like songbirds? Save their river habitats!
   - Show how YOU keep the river clean
   - Help the river by keeping leaves and grass out of streets!
   - Leave no pollution- ride a bike, turn off lights, reuse, recycle, restore
   - Plant native trees and shrubs!

3) **Big River Journey-** Draw what you did, saw or learned on Big River Journey
   - Show what you did or what you saw on the boat; include your favorite learning station or activity.
   - Draw the boat with you and your friends at your favorite learning station
   - What did the river look like from the boat?
   - Draw the boat with you and your friends viewing birds, animals, boats, buoys or the river confluence
   - What birds, wildlife or plant life did you see?
   - What did you see or do at Fort Snelling State Park?

4) **Journey to the Falls-** Draw what you did, saw or learned on Journey to the Falls
   - Show what you did or what you saw on the boat or at the stations
   - Draw the boat with you and your friends at your favorite learning station
   - What did the river look like from the boat?
   - Draw the boat with you and your friends viewing birds, animals, boats, bridges, the falls or other river sites
   - What did you see or do at the archaeological dig? Draw a picture!
   - What did you see or do on the history hike?

PRINT Neatly

Student Name	
Home Address City, State, Zip Code	
Student phone #	
Student Grade Level Circle student grade	**4** **5** **6**
School Name, City	
Teacher Name	
School Phone #	
Art Contest Category (circle ONE)	1) Mighty Mississippi 2) Caring for the River 3) Big River Journey 4) Journey to the Falls

Big River Art Contest 2013 - Ideas to get you started:

1) The Mighty Mississippi- This category is about the Mississippi River – its wildlife, plant life, scenery and recreation – and its relationship to you.

- Exploring the river with friends, canoeing, fishing, hiking, biking, etc.
- The river as a home for animals - turtles, frogs, mussels, beaver, otter, fox, deer, raccoon, etc. (Add a poem about the animal!)
- Birds and bird watching or the Mississippi River as a flyway
- Fish and fishing (portray specific species like catfish, paddlefish, or sturgeon)
- Aquatic insects (idea: show how aquatic insects are part of a food chain)
- Following animal tracks

2) Caring For the River- Here are some ideas:

- Drink water? Then help care for the river! It's our water source!
- Your street flows to the river!
- Be a friend of the Mississippi River!
- Do you like songbirds? Save their river habitats!
- Show how YOU keep the river clean
- Help the river by keeping leaves and grass out of streets!
- Leave no pollution- ride a bike, turn off lights, reuse, recycle, restore
- Plant native trees and shrubs!

3) Big River Journey- Draw what you did, saw or learned on Big River Journey

- Show what you did or what you saw on the boat; include your favorite learning station or activity.
- Draw the boat with you and your friends at your favorite learning station
- What did the river look like from the boat?
- Draw the boat with you and your friends viewing birds, animals, boats, buoys or the river confluence
- What birds, wildlife or plant life did you see?
- What did you see or do at Fort Snelling State Park?

4) Journey to the Falls- Draw what you did, saw or learned on Journey to the Falls

- Show what you did or what you saw on the boat or at the stations
- Draw the boat with you and your friends at your favorite learning station
- What did the river look like from the boat?
- Draw the boat with you and your friends viewing birds, animals, boats, bridges, the falls or other river sites
- What did you see or do at the archaeological dig? Draw a picture!
- What did you see or do on the history hike?

PRINT Neatly

Student Name	
Home Address City, State, Zip Code	
Student phone #	
Student Grade Level Circle student grade	**4** **5** **6**
School Name, City	
Teacher Name	
School Phone #	
Art Contest Category (circle ONE)	1) Mighty Mississippi 2) Caring for the River 3) Big River Journey 4) Journey to the Falls

Service-Learning Projects

Browse the project pages listed below to decide which one to do. For each, you'll find success stories, step-by-step instructions, and direct links to videos, curriculum, equipment, and people needed for that project. Or, research community needs and resources, then create your own project.

Popular Service-Learning Projects

- **Clean Up Trash** - Pick up trash along waterways to protect wildlife and make it more pleasant to swim, boat, or hike. When people see such a sign of care, they tend to take better care of a place.
- **Stencil Storm Drains** - Street runoff flows untreated into lakes, streams, and wetlands. Use stencils to paint "Do Not Dump! Drains to Lake" (Stream or Wetland) next to storm drains. Then leaflet houses to communicate simple tips to prevent pollution.
- **Test Soil for Nutrient Content** - Though most Minnesota lawns have plenty of phosphorus, many home owners still fertilize with it. Yet too much phosphorus causes algae blooms in lakes and rivers. Test soils, then report results to homes and businesses.
- **Compost Leaves and Grass** - Leaves and grass clippings are a major source of polluting phosphorus in lakes and rivers. Help residents properly dispose of yard wastes.
- **Habitat Action** - Plan, plant, and maintain a rainwater garden or other native habitat area to prevent erosion, slow runoff, increase infiltration into the ground, and support wildlife. Requires a long-term commitment, yet provides long-term educational opportunities.
- **Monitor Water Quality** - Volunteer monitors help public agencies watch water quality in Minnesota's many lakes and streams. Join monitoring networks for training, equipment, and materials.
- **Educate the Public** - Protecting lakes, streams and wetlands must involve everyone through simple acts such as picking up after pets and keeping grass clippings out of the street. Every pollution prevention project should communicate this message.

Pollution Prevention Project Guide

Website: http://cgee.hamline.edu/watershed/action/projects/

River-Themed Activity Ideas

- **Reading.** Read a book about the Mississippi River or another river. (See suggestions in "River Books" in Big River Teacher's Guide.)

- **History/geography/art.** Create a *"Landscape of Stories"* mural with the class. Create a large, colorful map of the Mississippi River (or the upper part of it) and use it for placing students' small story-posters or large postcards about various historical events and sites. Stories may include, e.g., geological origins of the river (show River Warren tributary), American Indian place-names and stories, natural history, fur trade, village and cities, explorers, etc. Draw pictures to go with the stories. Use reference materials such as river history posters (included in the Big River Teacher's Guide).

- **History.** Identify the origin of place names such as Mississippi, Minnesota, Mendota, Pike Island, Carver's Cave, St. Paul, Red Wing, Kaposia, etc. See "The Junction of Rivers" poster/guide about American Indians of the Twin Cities area, produced by the Minnesota Historical Society. Include on "Landscape of Stories" mural (see previous.)

- **History.** Write a paper about the Dakota culture of American Indians who lived along the river before arrival of more recent cultures; then find out about the Dakota today. See posters on river history produced by the National Park Service. Use exhibits and references from Fort Snelling State Park Visitor Center.

- **Geography/history.** Compare modern maps of the river with those of 100 or 200 years ago. Identify how the maps are different. How has the river or land changed?

- **Reading.** Read and discuss folk tales, oral traditions and songs about the Mississippi River. (See lyrics to several Mississippi River songs in Teacher's Guide.)

- **Art.** Draw or paint the Mississippi River based on your field trip experience or other interaction with the river. Make a poster about how to care for the river.

- **Music.** Listen to various river music. Use the video "Mississippi Singing" to hear samples of several songs, or listen to the CD "Great Mississippi" by Singing Ranger Charlie Maguire (both available from the Mississippi National River and Recreation Area, http://www.nps.gov/miss/home.htm.) Learn the song "Great Mississippi" by Charlie Maguire. (Sheet music available from MNRRA, 651-290-3030, x231.)

- **Writing/poetry.** Write a poem about the river; read it to the class. (See page inTeacher's Guide to explore various forms of poetry.)

- **Reading/writing.** Collect river-related news stories from newspapers. Share them with the class. Arrange them into your own "River Times" newspaper. Add your own stories and pictures, make your own title, and write an editorial for your paper.

River-Themed Activity Ideas, cont'd

- **Science.** Learn about *the water cycle*, and draw a diagram to show how streams, rivers, groundwater, lakes and oceans are all connected. Is it true that the earth is "one body of water?"

- **Service education.** Identify and carry out a project to benefit the Mississippi. Examples include educating others about run-off pollution, stenciling storm drains, cleaning up litter, and planting native trees, shrubs and grasses. (See "Pollution Prevention Project Guide" or the website, http://cgee.hamline.edu/watershed/action/)

- **Science.** Use the "Enviroscape" model (available from the Center for Global Environmental Education, or Minnesota Valley National Wildlife Refuge, or Project WET) for learning about runoff pollution and how to prevent it. It's a fun and easy to use model that really attracts kids. The "Enviroscape" includes curricula, and can be used with K-12 students.

- **Social studies/science/art.** Learn about various boats used on the Mississippi in the past and present. Write about how and for what they were used, when used, and unique features. Illustrate your report with a drawing of the vessel, or make a model.

- **Social studies.** View the PBS NOVA video on the flood of 1993 (available for check-out from Mississippi National River and Recreation Area); discuss how ways that people use the river could be changed to reduce flooding and its problems. View "Mississippi Singing" video (available for check-out from the Mississippi National River and Recreation Area) to identify and evaluate various uses of the river, and which are most important to you.

- **History/writing/theater.** Learn what it was like to live on the river one century ago in St. Paul. Then write a make-believe diary about your life, and that of your family and friends. Make it into a short play, and perform it for your class.

- **History.** See The Story of Minnesota's Past by Hillary Wackman and Nancy O'Brien Wagner. The Northern Lights educational program includes an Annotated Teacher's Edition, a Student Edition and a Classroom Resources Workbook, published by the Minnesota Historical Society.

- **Art.** Explore innovative art based curricula that links art and the environment, reuse and recycling. Website www.artstart.org.

3.
Big River Journey Field Trips

Big River Journey:
Mississippi River classroom activities
and educational resources

Big River Journey
On-board Learning Stations

Station 1: Aquatic Invertebrates
Students will examine aquatic bugs under microscopes and learn of their significance in assessing water quality. Leeches and snails, for example, tolerate poor water quality and are found in most bodies of water. Other species, like dragonfly nymphs, require cleaner water and are found in unpolluted lakes and rivers. Get a close-up view of numerous aquatic invertebrates. *(Presenter: Science Museum of Minnesota)*

Station 2: River Birds
Using binoculars, students will observe river birds from the open-air observation deck of the boat. They will investigate birds' activities and their uses of the river to meet their needs for survival. Students will record observations and discuss birds' adaptations to the river habitat. Migration along the river and the importance of protecting and managing the river to provide for birds' needs will be discussed. *(Presenter: Saint Paul Audubon Society)*

Station 3: Adopt-A-River Crime Lab (River Stewardship)
Students will examine samples of Mississippi River shoreline litter for evidence of its origins. They will be able to observe and discuss the relationship between river debris and objects washed through the drains of city streets. This lesson will be underscored by viewing some of the 31 Saint Paul city storm water outfalls along this stretch of the Mississippi River. By learning the linkages between river rubbish, street drains, and storm water outfalls along the river, students will come to understand the concept of watersheds, and learn how to prevent a major source of river pollution. *(Presenter: Minnesota Department of Natural Resources)*

Station 4: Mystery of the Disappearing Waterfall (River Geology)
Students will examine and describe samples of the three sedimentary rock types (limestone, shale and sandstone) found in local river outcrops. Actual outcrops will be observed and students will stack their sample rocks to match the strata (layers) seen in the outcrops. Students will discover the reason for the migration of St. Anthony Falls from St. Paul to its current location in Minneapolis. The primary significance of river geology in the establishment of the Twin Cities will be discussed. *(Presenter: Mississippi National River and Recreation Area)*

Station 5: Ecosystem-Ottersystem
Students will learn about the life and habitat requirements of the river otter, a pollution-sensitive predator in the floodplain ecosystem. Observations of plants, animals, and habitat conditions of the floodplain forest will then be evaluated and recorded as being beneficial or harmful for otter survival. Binoculars and poster guides of river plants and animals will be available to aid in ecosystem observations. Students will note evidence of flooding observed along the route; the effects of flooding cycles and human activities will be discussed. *(Presenter: Mississippi National River and Recreation Area)*

Station 6: Riverboats & Piloting
Students will visit with a captain (pilot) from the Padelford Boat Co., who will describe navigational instruments used in the pilot house, how a large river vessel operates, and what it takes to become a U.S. Coast Guard licensed riverboat pilot. The pilot will also show and describe use of river maps & charts. *(Presenter: Padelford Packet Boat Co.)*

Note: Activities may be modified from above descriptions, or new stations may be substituted.

Big River Journey
Land-based Learning Programs
(on one-way trips at Fort Snelling State Park only)

Classes on one-way trips will be provided with ***one*** of the following programs at Fort Snelling State Park:

Program A: Ft. Snelling State Park Artifacts
The natural resources and the confluence of the Mississippi and Minnesota rivers have drawn people to this area for thousands of years. The intertwining of natural and cultural history of the Fort Snelling area will be explored through artifacts. Presentation addresses occupation of the area by Dakota Indians, the fur trade, Historic Fort Snelling, and more. Artifacts found nearby will be used to tell the story of the area. *(Presenter: Fort Snelling State Park)*

Program B: Soldier Hike
A uniformed 1827 soldier from Historic Fort Snelling will lead a hike explaining why the junction of the Mississippi and Minnesota Rivers was chosen by the United States government as the key place to regulate the fur trade. He will show and describe several topographical and man-made features of the area such as the oldest road in Minnesota and the historic boat landing, and demonstrate how a flintlock musket works. *(Presenter: Minnesota Historical Society, Historic Fort Snelling)*

Program C: Cultural Crossroads (hike)
An interpreter from Historic Fort Snelling will lead students on a short hike during which they will discover plants and animals available to the Dakota people and learn how they were used as part of daily Dakota life. They will also learn how trade with other American Indians and Europeans-Americans brought access to a variety of different resources from throughout North America and the world. The interpreter will also talk about the historical significance of this area for American Indians and European Minnesotans. *(Presenter: Minnesota Historical Society, Historic Fort Snelling)*

Program D: Floodplain Forest Hike
A naturalist will lead the group on a short hike to explore interactions of the river with plants and animals of the floodplain forest in the river confluence area. Natural and historic features will be encountered and discussed. *(Presenter: Fort Snelling State Park)*

Big River Journey
field trip preparation & logistics

- **Cooperative groups, station assignments, nametags, chaperones, lunches, clothing, accessibility/ special needs**
- **Payment & scholarships**
- **Sequence of on-board activities**
- **Schedules; Round trips vs. One-way trips**
- **Bus drop off and pick up**
- **Fort Snelling State Park information (for one-way trips)**

Cooperative Groups

Teachers must organize their class into cooperative groups in advance. Each group should have approximately four students. Students will work together in the same group until learning stations are completed.

Learning Station Assignments

Each cooperative group will visit three on-board learning stations (and one land-based station if applicable) in a particular order. Use the Big River Journey- **Student Learning Station Assignment Template** (following in this Teacher's Guide) to assign students to a learning station rotation schedule. All students at a school should be equally divided among the stations. Students will attend either even numbered stations or odd numbered stations in one of three sequences. ***It is the teacher's responsibility to assign groups to their learning stations and to make nametags (see template provided)***. It is suggested that students share about their various learning experiences in the classroom after the trip.

Anson Northrup riverboat learning stations

#1) Aquatic Invertebrates (river insects)
#2) River Birds
#3) Crime Lab (river stewardship)
#4) Mystery of the Disappearing Waterfall (river geology)
#5) Ecosystem-Ottersystem
#6) Riverboat Piloting

Fort Snelling State Park learning stations (on one-way trips only)

A) Ft. Snelling State Park Artifacts
B) Soldier Hike
C) Cultural Crossroads (hike)
D) Floodplain Forest Hike

Nametags

It is the teacher's responsibility to ensure all students have nametags. All students must wear a nametag when boarding the riverboat. The nametags should include the student's name and the learning station sequence to which the student is assigned. Teachers may use the name tag template (following) or provide the same information on another type of nametag.

Chaperones

Chaperones are very important to a successful field trip. One free adult (teacher/chaperone) per 15 students is allowed. Additional chaperones are allowed but must pay the full $8.93/person rate. A teacher or chaperone with each rotation group is best; we suggest one teacher or chaperone per 10 students.

Please help us by having teachers and other adult chaperones take an active role in assisting students at the learning stations (however, they should not do the students' work for them). Chaperones set an important example by listening and engaging with the activities. If necessary, we may ask teachers or chaperones to assist with behavior issues. Please share logistical information with chaperones so they know what to expect. All adults should refrain from making phone calls while on the boat.

Lunches

Time for lunch is provided on one-way trips at Fort Snelling State Park. An area to store lunches will be set aside on the Anson Northrup riverboat and at Fort Snelling State Park. Do not leave lunches on the bus, since buses are sometimes routed elsewhere before lunch. It works best if lunches are collectively stored in a number of coolers or other large containers rather than carried individually by students. No food or drink is available for purchase, and no food or drink should be consumed while aboard the Big River Journey riverboat.

Weather & Clothing

Dress warmly, and be prepared for inclement weather, rain and mud! It is much colder on the river than around school, and several of the stations are in the open air. Land-based stations take place rain or shine. In the event of flooding, we will notify school contacts by email as to any necessary changes at least one week before your trip.

Accessibility, Special Needs

The Anson Northrup is wheelchair accessible to the lower deck where all students board. Please inform us in advance of accessibility needs or other special needs that we should be aware of. Big River Journey partners are committed to making these trips as accessible and appropriate as possible for all students. Accommodations may be available that can help provide for special needs. A video of the riverboat piloting learning station is available *when requested in advance* for students unable to access that station. Other station set-ups can be arranged by advance request.

Payment and Scholarships

Payment

Big River Journey cost is $8.93 per person unless on scholarship. Padelford Packet Boat Co., 651-227-1100, will bill participating schools. ***Payment must be made to Padelford before students can board the boat.***

Scholarships

Eligibility: Either your school's percentage of students of color, or your percentage of student enrollment in the free-and-reduced lunch program, must be at least 50%. **DO NOT ASSUME** that your school will receive a scholarship just because it is eligible. The steps to receive a scholarship are:

1. **If your school is eligible, request a scholarship when registering for a trip.**

2. **Confirm your eligibility in a letter signed by your principal.** We require a statement (by mail or by fax, 651-290-3815) from the school's principal indicating the basis for the school's eligibility. Include the specific percentage of students of color and/or the specific percentage of students on free-and-reduced lunch that qualifies. You are not approved for scholarship until this statement is received by the National Park Service.

3. **You will pay only $3.93/student to Padelford Boat Co. for your BRJ trip.** Eligible schools pay only $3.93/student for Big River Journey paddleboat trips. The remainder of the boat fee will be covered by the scholarship. Adults are not covered by the scholarship. When arranging payment with the Padelford, be sure that they know you are a Big River Journey Scholarship School (a list of confirmed schools is provided to the Padelford). When you receive an invoice from the Padelford Boat Co., **please pay your portion ($3.93/student, plus any adults at full fare) of the Padelford bill, and indicate on the invoice that you are a BRJ Scholarship School.** The remainder of your bill is paid by our scholarship fund.

4. **You are responsible for reserving and paying for your school's buses.** Be sure to note required pick-up and drop-off times and locations indicated in this guide.

5. **If you have questions**, contact us: 651-293-8414 (Brian) or 651-293-8426 (Lyndon)

Big River Journey Scholarships are provided by a grant from the Mississippi River Fund (MRF). MRF shares the belief that by connecting students to the Mississippi River and engaging them with activities that teach about the river and how to care for it, we contribute toward a healthy river future.

Big River Journey Scholarships
Mississippi National River & Recreation Area
111 E Kellogg Blvd., Suite 105
St. Paul, MN 55101-1256

Big River Journey Field Trips:
Sequence of On-board Activities (all trips)

Description

On-board activities are the same for both one-way and round trips. Each trip begins with a safety message and whole group introduction. Students are introduced to questions for each learning station which they will be expected to answer at the end of the trip.

After the introduction students go to their first learning station (first number on nametag.) An announcement over the boat PA system indicates when it is time to move to the second and third stations. After the third station all students again gather together as a whole group. A National Park Service Ranger asks students for the answers to the questions posed in the group introduction. Students should be able to answer the questions from information presented in the learning stations. Teachers are asked to encourage participation by students if needed.

Sequence of on-board activities

Total time of river trip: 1¾ hours

Convene on main deck; captain provides safety instructions. (5 min.)
Whole group introduction to the river & learning activities (10 min.)
Go to 1st station (5 min.)
1st learning station (20 min.)
Go to next station when announced. (5 min.)
2nd learning station (20 min.)
Go to next station when announced. (5 min.)
3rd learning station (20 min.)
All return to main deck when announced (5 min.)
Reconvene on main deck to share observations and learning (10 min.)

Questions for riverboat learning stations

Actual questions may vary somewhat.

#1) Aquatic Invertebrates (river insects)- Was it a good thing or a bad thing to have so many mayflies around the river? Why? How can insects such as macro-invertebrates tell us about the health of the river?
#2) River Birds- What birds did you see? What is a feature or adaptation of a bird you saw that helps it live along the river? What makes the river such a great place for birds?
#3) Crime Lab (stewardship)- What was in the bags of crime evidence that you examined? How did all the stuff get to the river? What can you do to prevent future river crimes?
#4) Mystery of the Disappearing Waterfall (river geology)- What happened to a great waterfall that was once in the area of downtown St. Paul? Why is that waterfall important to the cities of Minneapolis and St. Paul?
#5) Ecosystem-Ottersystem- What did you see along the river that would be beneficial or harmful to river otters? Do you think that floods on the Mississippi River help or harm river otters' ecosystem?
#6) Riverboat Piloting- What tools did the captain use today to pilot the riverboat? If you wanted to be a riverboat captain what subjects would you need to do well at in school?

Big River Journey Trip Schedules

BRJ schools are signed up for one of the following trip schedules:

Round trip 1 (*arrive at **Harriet Island at 9:30am**, end at **Harriet Island at 11:30am***)

9:30	**Bus arrives at Harriet Island**
9:30-9:40	Board boat (St. Paul Landing)
9:45	Depart from Harriet Island (St. Paul Landing)
9:45-11:30	On boat completing sequence of on-board activities
11:30	**Board buses at Harriet Island (St. Paul Landing) and return to school**

Round trip 2 (*arrive at **Harriet Island at 11:45am**, end at **Harriet Island at 1:45pm***)

11:45	**Bus arrives at Harriet Island**
11:45-11:55	Board boat (St. Paul Landing)
Noon	Depart from Harriet Island (St. Paul Landing)
Noon-1:45	On boat completing sequence of on-board activities
1:45	**Board buses at Harriet Island (St. Paul Landing) and return to school**

One-way trip 1 (*arrive at **Harriet Island at 9:30am**, end at **Fort Snelling State Park at 1:00pm***)

9:30	**Bus arrives at Harriet Island (St. Paul Landing)**
9:30-9:40	Board boat (St. Paul Landing)
9:45	Depart from Harriet Island (St. Paul Landing)
9:45-11:30	On boat in route to the River Landing
11:30	Arrive at the River Landing (Ft. Snelling)
11:30-11:45	Walk from the River Landing to the park Visitor Center
11:45-12:15	Eat Lunch
12:15-1pm	Learning Program (45 minutes)
1pm	**Board buses at Ft. Snelling State Park and return to school**

One-way trip 2 (*arrive at **Fort Snelling State Park at 10:00am**, end at **Harriet Island at 1:45pm***)

10:00	**Arrive at the Ft. Snelling State Park Visitor Center**
10:15-11:00	Learning Program (45 minutes)
11:00-11:30	Eat Lunch
11:30-11:45	Walk from park Visitor Center to the River Landing site
11:45-11:55	Board the boat and depart to Harriet Island
Noon-1:45	On boat in route to Harriet Island
1:45	**Board buses at Harriet Island (St. Paul Landing) and return to school**

QUESTIONS? CALL BRIAN AT 651.293.8414.

Types of trips: Round Trips vs. One-way trips

There are two types of trips; Round trips and One-way trips. **Round trips begin and end at the *same* place** (Harriet Island). **One-way trips begin and end in *different* places** (Fort Snelling State Park and Harriet Island). You may confirm the type of your trip by calling the National Park Service, at 651-293-8414 (Brian) or 651-293-8426 (Lyndon). There are **two trips every day.**

- **Round trip 1** (*arrive at **Harriet Island at 9:30am**, end at **Harriet Island at 11:30am***)
- **Round trip 2** (*arrive at **Harriet Island at 11:45**, end at **Harriet Island at 1:45pm***)
- **One-way trip 1** (*arrive at **Harriet Island at 9:30am**, end at **Fort Snelling State Park at 1:00pm***)
- **One-way trip 2** (*arrive at **Fort Snelling State Park at 10:00am**, end at **Harriet Island at 1:45pm***)

Bus drop off and pick up

Arrival times are when the *bus should drop you off*. Ending times are when the *bus should pick you up*. Other schools may also be on your trip. ***Your promptness is necessary to keep us on schedule, and important as a courtesy to other schools.*** Round trip duration is 1 hour, 45 minutes. One-way trip duration is 3 hours, 30 or 45 minutes, including time for a brown bag lunch. See detailed schedules for each type of trip on previous page.

Round trips will begin and end at Padelford Landing, Harriet Island, Saint Paul. See sheet with map and directions in this Teacher's Guide or see: *http://riverrides.com*.

One-way trips either begin at Harriet Island and end at Fort Snelling State Park **OR** begin at Fort Snelling State Park and end at Harriet Island. See maps & direction sheets.

Adresses:

- **Padelford Landing, Harriet Island, 100 Yacht Club Road W, Saint Paul, 55107.**
- **Fort Snelling State Park, 101 Snelling Lake Road, St. Paul, MN 55111**
  NOTE!: Fort Snelling State Park (101 Snelling Lake Road, St. Paul, 55111) is accessed via State Highway 5 at the Post Road exit. *Do not follow the brown highway signs to "Historic Fort Snelling" or you will go to the wrong place!*

Fort Snelling State Park information
(for BRJ one-way trips)

Location: Fort Snelling State Park (FSSP), 101 Snelling Lake Road, St. Paul, 55111, is situated at the confluence of the Mississippi and Minnesota Rivers and is accessed via State Highway 5 at the Post Road exit. (See map in Teacher's Guide.) When approaching the park from the east or west on Highway 5, look for the brown highway "Fort Snelling State Park" signs that direct you to the Post Road exit. ***Do not follow the brown highway signs to "Historic Fort Snelling" or you will go to the wrong place.***

Entrance: Once you are on Post Road, follow the road down the hill and into the park. The park's entrance office is at the base of the hill. **It is no longer necessary for school buses to purchase a permit to enter MN State Parks.** Proceed approximately 1½ miles to the park Visitor Center where your class will meet for land-based stations and lunch prior to boarding the Padelford boat. For those classes ending their trip at Fort Snelling State Park, the Visitor Center parking lot is the location your buses should pick you up.

Schedule: Each class will spend approximately 90 minutes at Ft. Snelling State Park. All classes will participate in an interpretive program that will be presented by either a State Park naturalist, staff from Historic Fort Snelling, or other partner organization. Time will be provided for all students to eat their own **brown bag lunch** at the park. (See detailed schedules on previous page.)

Boat departure and arrival times:

- Classes that begin at Ft. Snelling State Park at 10:00 will be led to the boat departure site and begin boarding the boat at 11:45; boat departs at 12:00.
- For classes boarding at Harriet Island at 9:30, departure is 9:45; boat arrival time at Ft. Snelling State Park will be approximately 11:30.

Boat arrival & departure location, and accessibility:

At Fort Snelling State Park, the boat will arrive and depart at the historic River Landing area. The walk from the park Visitor Center to the River Landing is approximately 3 blocks and will take about 10 minutes. If you have students in your class who will be in a wheelchair or have a mobility disability and need assistance over soft ground, *please contact the park prior to your visit* to make arrangements for these students to travel to or from the River Landing area.

In the event of flooding:

If the riverboat landing is flooded so boats can't land at FSSP, but FSSP remains open, the BRJ land-based programs will go on as usual. However, your buses will transport you between FSSP and Harriet Island; the boat portion of the trips will run as round trips. If FSSP closes due to flooding, land-based programs will be cancelled. School contacts will be notified of changes.

Learning activities: See program descriptions on a previous page (subject to change) and sample activity questions on next page. Program assignments will be made based on the numbered/ lettered nametags indicating learning stations. Dress for outdoor weather.

For More Information Contact: Kao Thao or Krista Jensen
Fort Snelling State Park
101 Snelling Lake Road
St. Paul, MN 55111
kao.thao@state.mn.us
krista.jensen@state.mn.us
Phone: 612-725-2724
Fax: 612-726-1391

Land-based activity questions (at Fort Snelling State Park):

A) Artifacts
- What is the difference between a fossil and an artifact?
- What can we learn from studying an artifact?
- Give an example of something you learned about this site from an artifact.

B) Soldier Hike
- Why did the U.S. Army come here in the 1820s?
- Why has this place been so important to people for so long?

C) Cultural Crossroads
- Who was living in Minnesota and along these rivers before the Europeans came?
- How did contact with Europeans change the way of life of American Indians?

D) Floodplain Hike
- What plants and animals live in the floodplain forest?
- How are the plants and animals able to survive flooding?
- How does the floodplain forest benefit the river, and vice versa?

Big River Journey - Student Learning Stations Assignment Template

1. Within each block, fill in the names of students. These are **cooperative groups**. An equal number of students should be entered in each of the six columns.
   The numbers indicate the order of learning stations students will attend on BRJ. Letter indicates Fort Snelling State Park station if applicable.
2. Use these numbers on **students' nametags**. Students must wear nametags with station rotation #'s when boarding boat.
   NOTE: Any one student will go to **either** even **OR** odd stations, and will attend one activity at Fort Snelling State Park (if on one-way trip).

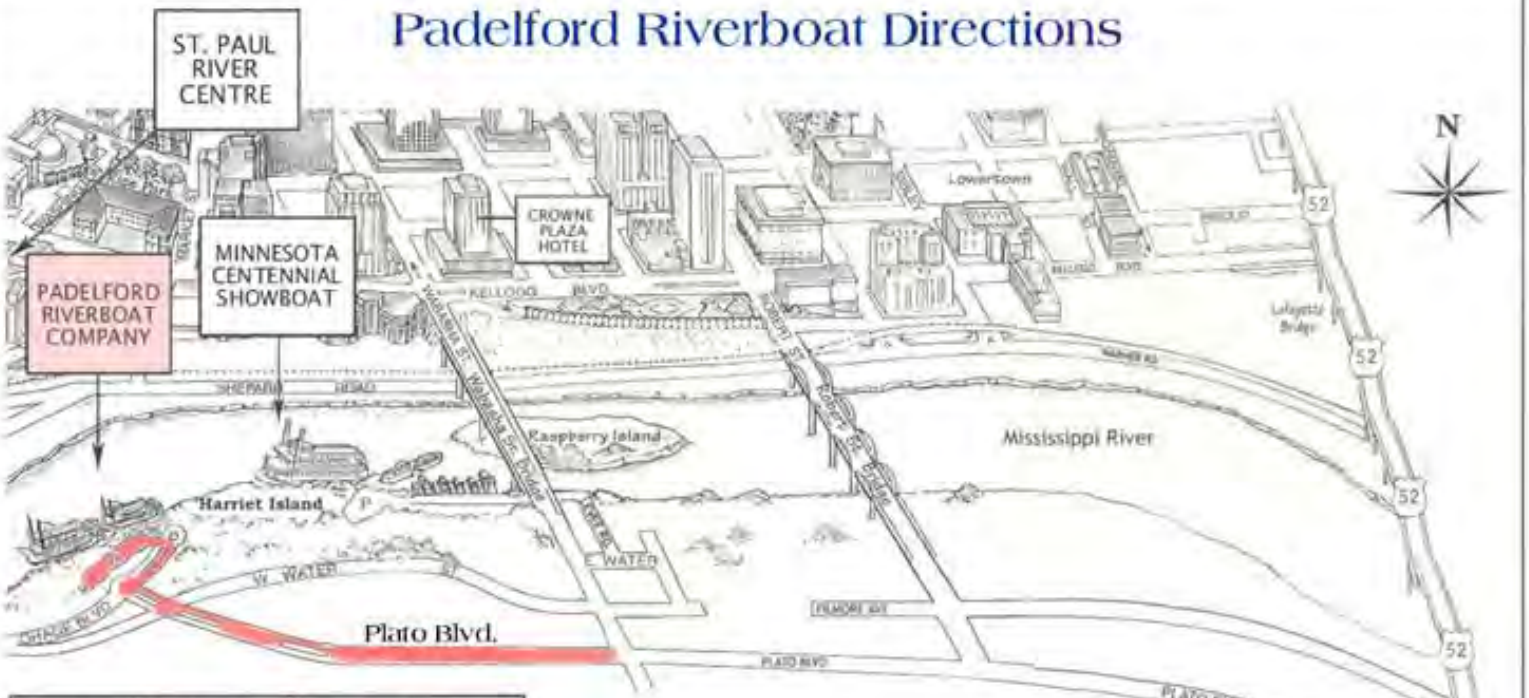
1, 3, 5 (A)	3, 5, 1 (C)	5, 1, 3 (A)	2, 4, 6 (B)	4, 6, 2 (D)	6, 2, 4 (B)

Nametag Template

All students must wear a nametag indicating station rotations when boarding boat.

_____ **NAME** ***1 – 3 – 5 (A)*** **STATIONS:** first-second-third (FSSP)	_____ **NAME** ***2 – 4 – 6 (B)*** **STATIONS:** first-second-third (FSSP)
_____ **NAME** ***3 – 5 – 1 (C)*** **STATIONS:** first-second-third (FSSP)	_____ **NAME** ***4 – 6 – 2 (D)*** **STATIONS:** first-second-third (FSSP)
_____ **NAME** ***5 – 1 – 3 (A)*** **STATIONS:** first-second-third (FSSP)	_____ **NAME** ***6 – 2 – 4 (B)*** **STATIONS:** first-second-third (FSSP)
TEACHER _____ **NAME** ***___ - ___ - ___ ( )*** **STATIONS:** first-second-third (FSSP)	**CHAPERONE** _____ **NAME** ***___ - ___ - ___ ( )*** **STATIONS:** first-second-third (FSSP)

Padelford Riverboat Directions



TO GET TO THE PADELFORD RIVERBOATS IN ST. PAUL AT HARRIET ISLAND WEST:

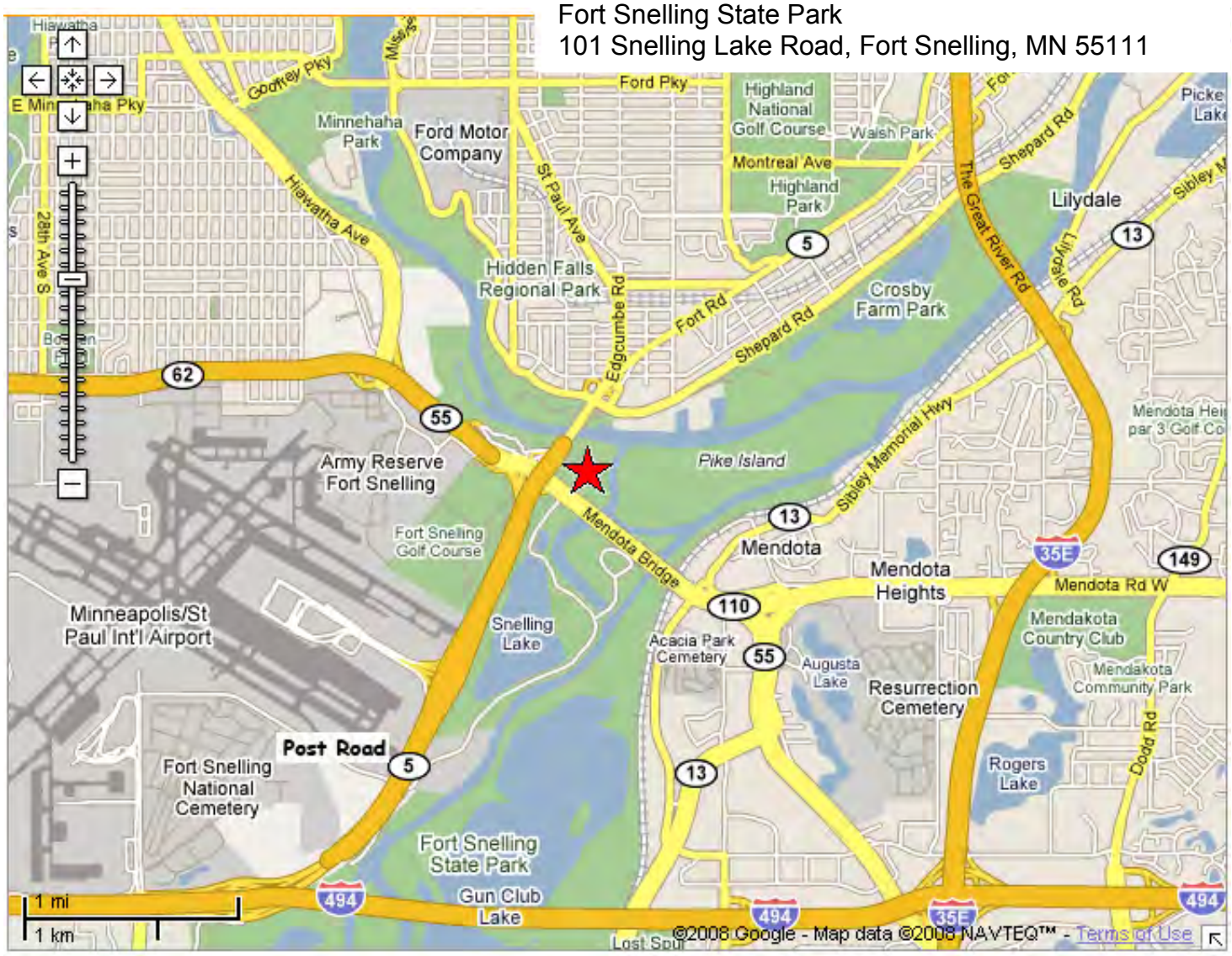
From downtown St. Paul, cross the river via the Wabasha St. Bridge, the Robert St. Bridge or the Lafayette Bridge (Hwy 52). Exit onto Plato Blvd. and head west (right). Follow the Harriet Island signs to Dr. Justus Ohage Blvd. Turn right to enter our FREE parking lot.

Padelford Boat Company
651-227-1100

Driving Directions to Fort Snelling State Park Visitor Center

Fort Snelling State Park is located in the lower Minnesota River Valley directly across Hwy 5 from the Minneapolis-St. Paul International Airport. As you approach the park from the east or west on Hwy 5, look for the brown state highway signs directing you to the State Park and the **POST ROAD** exit. *Do not follow the signs to Historic Fort Snelling* which is a different site nearby.
From Post Road follow the signs down the hill into the park.
After stopping at the entrance station, continue about 1 ½ miles to the Thomas Savage Visitor Center. Allow 5-10 minutes to drive from the Post Road exit to the Visitor Center parking lot.
Park phone numbers
Entrance Station: 612-725-2389
Visitor Center: 612-725-2724

Fort Snelling State Park
101 Snelling Lake Road, Fort Snelling, MN 55111



4.
Resources and Reference Materials

Big River Journey:
Mississippi River classroom activities
and educational resources

Key Words & Concepts

Water Cycle

water cycle – the continual process of water moving in various forms (liquid, vapor and solid) over and through earth's surface, ground, and atmosphere

precipitation – water moving from the air to the ground, such as rain snow hail or sleet

evaporation – process of water changing from liquid into vapor by application of heat

transpiration – process of water entering the atmosphere from plants

condensation – process of water changing from vapor into liquid droplets

surface water – water that flows or resides above ground in streams, lakes, rivers, and wetlands

ground water – water that flows or resides underground, including in water-rich layers called aquifers

river – a large natural stream of moving water that flows to a lake or ocean

wetland – area usually covered by shallow water, or containing waterlogged soil

glacier – water in the form of a large mass of slowly moving ice

ocean – very large body of salt water

watershed – land area from which water drains to a particular water body

Geology

geology - the study of the origin and history of the earth; the study of rocks

fossil - any remnant or evidence of life form from a past geological age, embedded in rocks

strata - layers of rock

erosion - breakdown or weathering of rocks, sediment or soil by wind, water, etc.

sedimentary - a classification of rocks created by deposits of sediment (particles of silt, sand, clay, etc.)

Ice Age - common name for the time during which glaciers were abundant

glacier - a large mass of slowly moving ice

geological era - a basic division of geological time, composed of one or more periods

geological period - a portion of a geological era

geological epoch - a portion of a geological period

Aquatic Invertebrates

aquatic – water-related; living all or nearly all of the life cycle in water

macroinvertebrate – an animal that lacks an internal skeleton and is big enough to be seen with the naked eye (examples: insects, worms)

tolerant – able to live in poor quality water; not sensitive

sensitive – not able to survive in poor quality water

high water quality – usually defined by cool water temperature, little suspended sediment, high level of oxygen, lack of pollutants, and presence of sensitive macroinvertebrate species

herbivore – an animal that feeds primarily on plants

nymph – immature phase of development in insects, often somewhat similar in appearance to the adult form, but with no developed wings and smaller in size (example: mayfly nymph→mayfly)

larvae – immature phase of development in insects, usually very different in appearance from the adult form (example: caterpillar→butterfly)

filter feeder – an animal that catches food drifting in the water

decomposers – organisms that break down dead organic material and make the nutrients available again to the ecosystem

Birds

adaptation – a modification in behavior, physical feature, or other characteristic that helps a living thing survive in its environment

migrate – to travel from one region to another, usually seasonally

flyway – broad geographical route commonly used by birds in migration

habitat - the surroundings where a plant or animal lives and finds the resources it needs for life, including food, water, shelter, and space

fresh water marsh – a wetland where fresh (non-salty) water normally exists all year

pond - a still body of water smaller than a lake, often shallow enough for rooted plants to grow throughout

forest – an ecosystem in which trees are the most dominant member

prairie – a grassland community; ecosystem in which grasses are dominant

wetland – a wet land with specialized soil and plants, regularly or always flooded, found on edges of rivers, creeks, ponds, lakes, depressions, bays or oceans

raptor – a bird with sharp talons and hooked beak that catches other birds and animals to eat, and often carries them off

fledgling – a young bird that has gotten its feathers for flying

Ecosystems

ecosystem – a group of plants and animals that interact and adapt to a physical environment, including climate, water, air, and soil

predator - an animal that eats other animals

prey - an animal that is eaten by another animal

niche - the role or function a plant or animal has in a community

population - all of one kind of plants or animals in a specified area

food chain - a series of plants and animals within an environment of which each kind serves as a source of nourishment (food) for the next in the series

food web - a complex, interlocking series of individual food chains

native species - a species originally living in and adapted to a given place

exotic species - a plant or animal introduced from a different area that competes with the native species

endangered species - a species in danger of extinction (dying out)

Boats & buoyancy

vessel – a craft designed to navigate on water; a boat, especially a large boat

hull – the framework or body of a boat

bow – the front of a boat

stern – the rear of a boat

canoe – a slender boat with pointed ends, propelled by paddles

paddleboat – vessel for carrying passengers and cargo, propelled by a paddlewheel

barge – a large, unpowered, flat-bottomed boat for transporting freight

tow – a group of barges tied together, usually with heavy steel cables

towboat – a powerful vessel used to push a tow of barges

buoyancy – capacity to remain afloat in liquid; upward force of a fluid on an object less dense than itself

displacement – the weight or volume of fluid displaced (pushed out of place) by a vessel (boat or barge)

grain elevator – storage silos or tall bins equipped with devices for hoisting and discharging grain into barges, trucks or train cars

terminal – end point of a transportation system; loading station on a transportation line

Urban watersheds & stewardship

watershed – the area of land from which water flows to a given stream, river or lake

stewardship – the act of caring for our environment

water pollution – any substance that contaminates water making it unfit or unhealthy for use

point source pollution – water pollution that comes from a single point such as a pipe

non-point source pollution – water pollution that comes from a large general area such as a farm field, construction site, yard, streets or parking lots (also known as "*runoff pollution"*)

sediment – particles of soil and solid material that can be carried by water or wind

erosion – process by which soil, sediment or other materials are worn away and moved by water or wind

nutrient – element or substance (such as fertilizer or decayed leaves and grass) that supplies food for plant growth, but which in large concentrations can cause pollution

runoff – water from snowmelt or rain that flows over land to a river or other water body

storm drain – opening in streets and parking lots through which runoff flows into underground pipes that lead to rivers, ponds or lakes (storm drains do *not* lead to a water treatment plant)

storm drain outfall – the end of a pipe leading into a river or other water body from a storm drain

impervious surface – land covering, such as concrete or asphalt, that does not allow water to pass through it into the ground

best management practices (BMPs) – preferred actions to prevent pollution

Mississippi River Facts

- The Mississippi is much more than a ribbon of water; it is a *watershed* that drains all or parts of 31 states and 2 Canadian provinces. It is the dominant watershed in North America, and drains 41% of the continental United States; it is the fourth largest watershed in the world, after the Amazon, Congo, and Nile.

- The name "Mississippi" comes from the Anishinabe people (Ojibway Indians.) They call the river "Messippi" or "Mee-zee-see-bee," which means "Big River" or "Great River." Dakota Indians called the river “Haha Wakpa,” meaning “River of the Falls” in reference to the falls now known as Saint Anthony Falls. They also call it “Tanka Wapka,” meaning "Great River."

- The Mississippi River is the fourth longest river system in the world when including the Missouri River tributary. The Mississippi itself stretches approximately 2,350 miles from Lake Itasca to the Gulf of Mexico. The actual length of the river may vary from year to year. Its length is now shorter than it was a century ago due to the cutting off of meanders, engineering and other factors.

- Over geological time the river has grown by the depositing of sediment at its mouth – this process even helped to create the Gulf states! Typically 250-500 million tons of sediment is carried annually to the Gulf by the river. Sediment deposits in the delta area of the Gulf have built “barrier islands” that help to protect inland areas from storms; however, levies now prevent river sediments from accessing and rebuilding these islands. Much sediment is also trapped behind dams.

- The Upper Mississippi River carved its path with the meltwater of receding glaciers from the last Ice Age 12,000 years ago. In geological terms, the Upper Mississippi from its headwaters to the Twin Cities is a very young river.

- The glacial River Warren Falls, one of the largest waterfalls ever seen in North America, thundered beside the area that is now downtown St. Paul 11,700 years ago. At that time the falls was likely nearly 200 feet high and a mile across. It was fed by a torrent of meltwater from Glacial Lake Agassiz coursing down what is now known as the Minnesota River valley. The location of the falls moved slowly upstream as a layer of soft sandstone rock eroded away beneath the hard limestone caprock, which then collapsed piece by piece. By 10,000 years ago the falls had passed the confluence of the Minnesota and Mississippi Rivers, and the falls we know as Saint Anthony Falls had begun carving a gorge on its way to its present location. Saint Anthony Falls is the only waterfall on the entire length of the Mississippi, and the gorge below it that divides Minneapolis and St. Paul is the river’s only true gorge.

- The place where the Minnesota River meets the Mississippi River was called "Makoce Cokaya Kin" by the Mdewakanton Dakota Indians, meaning "Center of the Earth." The river confluence was also referred to as “M’dota” or “B’dote,” a Dakota word used to name the present-day city of Mendota. The area is sacred to many Dakota.

- On Sept 21, 1805, Lt. Zebulon Pike first set foot on the island that bears his name at the

mouth of the Minnesota River. (Dakota Indians called the island Wita Tanka meaning "Big Island.") Pike sought to construct a fort (Fort Snelling) on the bluff overlooking the rivers, for which a treaty was made two days later. At that time the cities of Minneapolis and St. Paul did not exist, though in the early 1800's the Dakota Indian village of Kaposia (led by Little Crow) was located near what is now Mounds Park in St. Paul, and other Dakota villages were located along the Minnesota River.

- 241 species of fish are at home in the Mississippi River watershed; 292 bird species use the Mississippi Flyway. Other wildlife of the river, bottomlands and bluffs of the Mississippi watershed includes 57 species of mammals, 45 species of reptiles and amphibians, 40 different species of mussels, and countless invertebrates.

- The river and its major tributaries supply drinking water for more than 18 million people. The Mississippi River is both sewer and drinking water source!

- To enable towboats and barges to travel upstream from St. Louis, 29 locks and dams have been built between there and Minneapolis. A navigation channel is maintained at a depth of at least nine feet by a combination of dredging and wing dams that focus river flow to the center of the channel.

- A system of “River Miles” locates places along the Mississippi River. Mile measurements begin at the confluence of the Ohio River and proceed upstream. At Saint Paul’s Harriet Island you would be at River Mile 840, since you’d be 840 upstream from the Ohio River. Navigation maps and river signs called “daymarks” include these numbers.

- From 1880 to 1930, Minneapolis was the milling capitol of the nation (and sometimes the world!) because of the enormous power of the river's only natural waterfall, Saint Anthony Falls. The falls were first used to power sawmills, and later flour mills.

- The Mississippi River is the reason the Twin Cities exist where they do. Minneapolis grew around Saint Anthony Falls as a source of waterpower, while St. Paul was at the upper end of the commercially navigable river in the 1800’s, and thus served as major link in the transportation of people and products.

- The Mississippi National River and Recreation Area and its immediate surroundings in the Twin Cities metropolitan area contain 114 designated hazardous waste sites.

- At the mouth of the Mississippi River in the Gulf of Mexico there is an area of 5,000 - 8,000 square miles referred to as the “Dead Zone.” The Dead Zone is severely depleted of oxygen due to an overabundance of nutrients (from fertilizers, decaying plant matter, etc.) and contaminants carried into the Gulf from the Mississippi. Nutrients stimulate the growth of algae, which consumes oxygen as it dies. Because the everyday practices of people, agriculture, and industry caused the Dead Zone, it is by changing our everyday practices that we can restore the Dead Zone to good health.

- According to the U.S. Environmental Protection Agency, the leading cause of Mississippi River pollution is runoff from rural farmland and urban areas. Such runoff carries pollutants directly to the river without treatment.

River Books

The Adventures of Huckleberry Finn by Mark Twain
Viking Penguin, New York. 1953 *Grades: 6-Adult*
A boy and a runaway slave travel the Mississippi on a raft in an exciting and sometimes dangerous trip. The Mississippi River influenced much of Twain's work, even his pen-name (from a riverboat working command). While the language and dialect reflect their time, and can be discussed in class, Twain's humanity comes through.

Biography of a River: The Living Mississippi by Edith McCall
Walker and Co., New York. 1990 *Grades: 6-12*
This "biography" details stories of human interactions with the Mississippi, from Native Americans, European explorers, and immigrant settlers to modern engineers and dam-builders. The river "speaks" in the first person in the opening chapter. The emphasis on the "living" nature of the river underscores an important environmental lesson.

Flood: Wrestling with the Mississippi by Patricia Lauber
National Geographic Society, Washington, D.C. 1996 *Grades 5-12*
Flood… explains that the Mississippi's dynamic nature is to change its course, re-arrange the land, and leave its banks, occassionally causing great flooding. We try to control the river, but are not always successful. Well illustrated. The book asks how we should manage the Mississippi's future, but falls short of a full look at restoration and alternatives.

Historical Atlas of the Earth by Stephen Jay Gould, et. al.
Henry Holt Reference Book, Henry Holt & Co. 1996
This large beautifully illustrated book describes the evolution of Earth landscapes to the present. Forces shaping the Earth, evolution of life, and ecosystems are depicted.

Horns and Wrinkles by Joseph Helgerson, Houghton Mifflin Company, Boston. 2006
Grades 4-7
Along a magical stretch of the Mississippi River near Blue Wing, Minnesota, twelve year old Claire and her bullying cousin Duke are drawn into an adventure to save family and friends turned to stone by a river spell. Cousin Duke struggles with a Pinocchio type horn which grows each time he refuses to perform an act of kindness while Claire navigates through tricky situations involving river characters such as Bodacious Deepthink the Great Rock Troll, a helpful fairy, and a group of trolls looking for their fathers.

Little Crow: Taoyateduta: Leader of the Dakota by Gwenyth Swain
Borealis Books, Minnesota Historical Society Press. 2004 *Grades: 3-adult*
This book shows a clear, sympathetic telling of the life of Little Crow from his childhood on the banks of the Mississippi River near what is now St. Paul to his death in July 1863. *Little Crow* offers an accessible account of both the man who led the Dakota into war and the causes behind that wrenching conflict. Swain's story is an excellent starting place for both young and older readers to begin understanding the context of the Dakota War of 1862.

Minn of the Mississippi by Holling Clancy Holling
Houghton Mifflin, Boston. 1951 *Grades: 4-8*
The journey of Minn, a snapping turtle, is followed from northern Minnesota to the bayous of Louisiana. The turtle's adventures with people, animals, and the changing seasons are vividly described, and bring the river's history to life. Wonderful drawings and maps accompany the story. Newbery honor book.

Mississippi by Diane Siebert, illustrated by Greg Harlin
Harper Collins. 2001 *Grades: 1-6*
A poetic journey down the length and breadth of the Mississippi River, this picture book depicts the origins, nature, human interactions and changes of the great river.

The Mississippi River (Ecosystems of North America series) by Maria Mudd Ruth
Benchmark Books/Marshall Cavendish, Tarrytown, New York. 2001 *Grades: 4-10*
An excellent exploration of how the Mississippi River works ecologically, this well illustrated book examines the relationship between the river and its backwaters, floodplains, watershed, delta, plant life, animal life, and human life. Poses questions of the river's future, articulates key science concepts, includes activities, glossary, and references.

Mississippi River: A Journey Down the Father of Waters by Peter Lourie
Boyds Mills Press, Honesdale, PA. 2000 *Grades 4-9*
Author Peter Lourie travels the modern Mississippi by canoe and over land from Lake Itasca to the delta. Feel the river change from a peaceful shallow marsh to an industrial ocean port. Along the way you will travel through a navigation lock, explore historic sites, share the river with mighty barges, and hunker down for a hurricane in New Orleans.

Our Endangered Planet: Rivers and Lakes by Mary Hoff and Mary M. Rogers
LernerPublications, Minneapolis. 1991 *Grades: 4-9*
A global look at the importance of water and its stewardship. Many illustrations and photographs communicate key water concepts, such as "we all live downstream."

Painting the Dakota: Seth Eastman at Fort Snelling by Marybeth Lorbiecki
Afton Historical Society Press, Afton, MN. 2000 *Grades: 4-adult*
Extraordinary watercolor paintings by an Army lieutenant depict Dakota Indian life in the area around Fort Snelling and the confluence of the Minnesota and Mississippi Rivers during the early-mid 1800s. From prairie and river landscapes to images of hunting, gardening and village life, Eastman's paintings and Lorbiecki's text bring the reader closer to the life and customs of the Dakota at a turning point both in their history and that of the Minnesota landscape. A useful complement to the book is the video, "Seth Eastman: Painting the Dakota," which includes the commentary of Dakota people (produced by Twin Cities Public Television and Afton Historical Society Press).

River of Words: Images and Poetry in Praise of Water edited by Pamela Michael, with introductory essays by Robert Hass and Thatcher Hurd
Heyday Books, Berkeley, CA. 2003 *Grades: K-12*
The remarkable, colorful art and insightful poetry of children from kindergarten through twelfth grade showcase the learning and thinking of students about rivers and water, and the beauty and life that water provides. With an equal balance of art and poetry, this book is a model and an inspiration for working with students in the classroom through the arts. The book is the outgrowth of River of Words, an international poetry and art contest and corresponding curriculum, available online at www.riverofwords.org.

River of Words: Young Poets and Artists on the Nature of Things edited by Pamela Michael, and introduced by Robert Hass
Milkweed Press, Minneapolis, MN. 2008 *Grades: K-12*
Poetry expressing children's connection to nature and water is featured in this book, the result of the annual River of Words poetry and art contest. Student artwork is secondary to the writing in this compilation, but adds color and expression. Joy, fear, enchantment, wonder and play are on exhibit. A wonderful model for student writing, this book is rooted in place-based, hand-on experience and observation – of watersheds and nature in one's local community. Milkweed Press website has a study guide for River of Words at www.milkweek.org.

The River That Gave Gifts: An Afro-American Story by Margo Humphrey
Children's Book Press, San Francisco. 1987 *Grades: K-5*
Four children in an African village make gifts for wise old Neema. Yanava does not know what to give and seeks inspiration from the river. In addition to themes of respect for elders and validity of different kinds of achievement, the river is portrayed as a source of power.

Rivers (Make It Work! series) by Andrew Haslam & Barbara Taylor
Two-Can Publishing, London. 1996 *Grades: 3-9*
Hands-on science and geography models and experiments fill this colorful, practical book about rivers and their features. Explores water cycle, river sources, drainage patterns, waterfalls, dams, deltas, human uses of rivers, flooding, managing rivers, and more.

Rivers and Lakes by Simon Holland and Anna Lofthouse
Dorling Kindersley Limited, New York. 2003 *Grades: 3-9*
Packed with facts, this accessible text incorporates excellent photographs and a glossary of terms explaining important words to do with rivers and lakes around the world. Physical characteristics of rivers are described, along with the biological life within them.

Tomorrow the River by Dianne E. Gray, Houghton Mifflin, Boston. 2006 *Grades 6-8*
In 1896, fourteen year old Megan joins her sister and family on their steamboat for the summer riding up the Mississippi River towards St. Paul, Minnesota. Through all of her adventures, learning to swim, navigate the river, take photographs, and work at a clamming business, Megan realizes what is her "true calling." Newspaper articles give hints about the characters whom Megan meets and are an integral part of the plot. History and river life are skillfully woven into the fast-moving plot.

Walter Meets Mack by Michael Stoesz. Beaver's Pond Press. 2011 *Grades 4-12*
Based on research and historical fact, *Walter Meets Mack* is as much a Minnesota history and social studies resource as it is a novel. For any class using the *Northern Lights* Minnesota History textbook, *Walter Meets Mack* is a fine curriculum supplement. Readers will learn many of the Minnesota Social Studies Standards. Plot summary: Sixteen-year-old Walter arrives at Minneapolis' bustling riverfront at the turn of the 20th century from Finland, and ends up working in the northern Minnesota logging camps. Although Walter makes a living cutting down mature pines, he sees logging's devastating effects on the environment.

The Wind in the Willows by Kenneth Grahame; illustrated by Ernest Shepard
Aerie Books, New York. 1988 *Grades: 3-adult*
This wonderful, humorous classic, filled with the curious lives of eccentric animal characters, takes place along a river. The scenic descriptions accurately reflect the habitats of each animal. While the book is often read aloud to younger children, the pace and comic conversations makes it highly entertaining for adults. Includes some challenging vocabulary.

Mighty Mississippi Discovery Backpacks

Explore the Mississippi River with a Mighty Mississippi Discovery Pack! The packs are ideal for families or groups. Each pack includes set of fun activity cards filled with ideas and activities for discovering the plants, animals, rocks, and environment found along the Mississippi River. All the exploration gear- binoculars, field guides, magnifying glasses, bird call *Identifliers*, and more- needed to explore is included.

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4900 Mississippi Court, Minneapolis 763-693-7693

Discovery Backpacks are developed by the Mississippi National River and Recreation Area of the National Park Service and offered in cooperation with partner sites. The Backpacks are made possible through a grant from the McKnight Foundation and the Mississippi River Fund (National Park Foundation.) Visit **http://www.nps.gov/miss** to learn more about the Mississippi National River and Recreation Area and the Backpack program.

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Great Mississippi!

-verse-

Born everyday at Itasca
Over Saint Anthony Falls
She rolls through the heart of this country
She rolls through the hearts of us all

-refrain-

She's the Great Mississippi
She's a winding road
Every turn, every bend
Will bring you back again
For a story told

-additional verses-

She is a wide-shouldered river
Taking the Rockies high mountain snow
And the soft spring rains of Virginia
Along with her as she goes

Rolling over Saint Peter Sandstone
Twisting down Glenwood Shale
Bearing down on Platteville Limestone
For 12,000 years she's been there

She's the *"Rio Escondido"*
The *"Sassagoula"*, the *"Mee-zee-see-bee"*
She has a river of names from her people
Twenty-four-hundred miles to the sea

GREAT MISSISSIPPI-Words and Music by Charlie Maguire
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National River

-verse-

"Great Mississippi"
In the "U.S.A."
"Old Man River"
Rolling Away
If everybody here
Will lend a hand
We'll bring this "National River" back again...

-refrain-

Takes a lot of hands
To care for the river
Takes a lot of voices
To protect her name
Takes a lot of hearts
To love a river
To bring this "National River" back again

-additional verses-

Mississippi River
"Red, White, and Blue"
Eagles are flying
Over the water too
If everybody here
Will take a stand
We'll bring this "National River" back again...

Mississippi River
From end to end
"National River"
"All American"
If everybody here
Will make it their friend
We'll bring this "National River" back again...

NATIONAL RIVER-Words and Music by Charlie Maguire
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First Nations

-refrain-

First Nations, on the River
First Nations, on the River

-verse-

Dakota, Iowa, Anishaabe, Mesquakie

-additional verses-

And they called it,
Mee-zee-see-bee, Chauqua,
Tapata, Sassagoula

Falling Water, *Owahmenah*
River of the falls, *Ha Ha Wakpa*
The severed rock, *Kakabikah*

And they lived at,
Hole in the Day
Kaposia
Remnicha
Wabasha

Dakota, Mesquakie, Illinois, Miami,
Anishaabe, Tionontati

Reverend Hickman's Hands

Reverend Hickman's Hands, were those of a working man
Swinging a hammer and splitting rail, by the light of day

Reverend Hickman's Hands, were those of a preaching man
At night they built a boat to take the Pilgrims away

Oh Pilgrim!
Run to the river, run to the river
Run to the river, the river in prayer!
Oh Pilgrim!
Run to the river, run to the river
For freedom, freedom, freedom, waiting there!

Reverend Hickman's Hands, were those of a fearless man
When the cry went out, they were long, long, gone
Reverend Hickman's Hands were those of a preaching man
No man, no woman, no child, will ever get caught

Stories say they built a boat
Glory on the River!
A raft of logs, anything that floats
Glory on the River!
Jefferson City they did go
Glory on the River!
Underground, underground railroad
Glory on the River!
War Eagle they hooked a ride
Glory on the River!
Towed or rode on the riverside
Glory on the River!
Up the Mississippi to Saint Paul
Glory on the River!
Founding congregation one and all
Glory on the River! Glory on the River! Glory on the River!

Reverend Hickman's Hands, were those of a river man
Down the wide Missouri and up the Mississippi too
Reverend Hickman's Hands, were those of a preaching man
And he guided on the Bible and the river to see him through!

Pilot Daddy

-verse-

There is a tow coming upbound
Keeping to the red
Taking all nine feet
Your Pilot Daddy is going to get you out of bed
Sitting in the high seat
Ready with your steel toes
Lace them in the dark
One hand for the boat now
Your Pilot Daddy, he was born to bark
This ain't no Romeo

-refrain-

And you're all going out to show
Just how much a line deckie don't know
Swap Now!
Trade up the rigging
Your Pilot Daddy is on the radio
Swap Now!
You can hear him singing
"One, two, three, four,
Puzzle out that tow"

-additional verses-

A barge ain't nothing but a hole in the water
For moving the Midwest
Your Pilot Daddy has no papers on one
So he's talking to the office
When he bumps
You move as quick as you can
One hand for the boat now
Your Pilot Daddy he is going to keep you safe
He's got the know how

Two boxes on the stern
Three rakes on the head
Notch on the portside
Your Pilot Daddy is making his bread
Watching how it all rides
There's a tow coming upbound
Keeping to the red
Taking all nine feet
Your Pilot Daddy is going to get you out of bed
Sitting in the high seat

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Take A Look

-verse-

Heard about her in a song
Read about her in a book
Go down to the riverbank yourself and take a look

-refrain-

Go down, take a look at that river
Go down, I'll introduce you to her
Big river Mississippi, surely is a friend of mine

-verse-

Big river Mississippi, she's wide and fair
But behind a big city she gets lost down there (refrain)

-bridge-

Big River Mississippi I found my home
Graceful as a dancer when I wake up in the morning
She's my long-time pal, it's true
We met the same way I'm telling you

-additional verses-

If you can't see her even driving slow
Pull over and park, go down and say hello (refrain)

In 1988, the Congress did say
"She's a national river, she ought to stay that way" (refrain)

TAKE A LOOK-Words and Music by Charlie Maguire
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Carver's Cave: Spirit Dwelling, Alliance Cave, Landmark

Many accounts of Carver's Cave, located near the Mississippi River at the base of Dayton's Bluff in St. Paul, recall its rich and varied past. To Dakota Indians the cave was a dwelling place for spirits and a meeting place for alliance. To early European explorers it was a landmark, while nineteenth century immigrants viewed the cave as a tourist attraction. To industrialists it was in the way. To those touched by the cave's history today, it remains a teller of remarkable stories.

Sketch above: **Members of the Minnesota Historical Society examining Carver's Cave by candlelight in 1867, on the centennial of Carver's exploration of it. A rattlesnake is depicted on the cave ceiling.**
Artist: Robert O. Sweeny, courtesy Minnesota Historical Society.

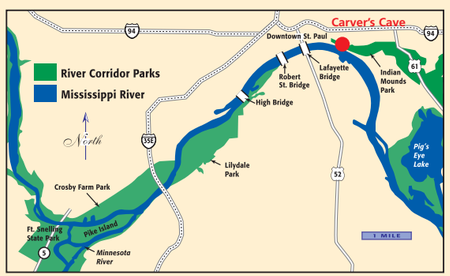
Wakan Tepee

Dakota Indians have called the cave "Wakan Tepee," which may be interpreted as mysterious house, spirit dwelling, or church. On the cave's soft walls were carved images of animals including rattlesnakes, bears, birds, fish and turtles, as well as humans. Each petroglyph possessed meaning. Though the carvings' origins are uncertain, to the Dakota, rattlesnakes represented fear and control over humans; the bear was known as the animal closest to humans.

Alliance Cave

Carver's Cave is better known as Alliance Cave to many Dakota. An alliance of 56 Indian nations called "Wodakota" is said to have met at the cave to keep peace ("wookiye") and maintain good relations. This great alliance included Nakota, Dakota, Lakota and Sakota peoples. The cave's location was central to the system of rivers by which Alliance members traveled. The lake inside the cave could accommodate large canoes and decision-making business may have been conducted without leaving the canoes. Decisions are said to have been made with consideration for seven generations to come.

Graphics above and at right: **Petroglyphs in Carver's Cave.** Theodore H. Lewis sketched the animal figures depicted here in 1878. Four are of rattlesnakes, each between 3' and 5' long, and averaging 1½" deep; all pointed toward the center of the cave at its widest part. The other two sketches may be of bears; the animal at right may be a bison.



Location of Carver's Cave near Mississippi River

European Discovery

In 1766, Jonathan Carver, a British explorer whose name is now applied to the cave, became the first white person to visit and describe the cave. He wrote about its floor of fine white sand, its petroglyphs, and the lake that began twenty feet from the entrance and extended "an unsearchable distance." Carver's best selling book about his travels in the interior of North America, first published in 1778 and later reprinted in 53 editions in nine countries, made Carver's Cave a landmark known around the world.

Photo at far left: **Boy Scouts exploring interior of Carver's Cave, 1930.**
Photo courtesy Minnesota Historical Society.

Photo at left: **Re-opening of Carver's Cave, November 5, 1913.**
Photo courtesy Minnesota Historical Society.

Destruction and "Rediscovery"

In 1869 and 1885 several hundred feet of the bluffs housing the cave were cut away to make room for the railroad. The excavations reduced the size of the cave, and the cave's entrance became obscured following the resultant landslides.

In 1913 the cave's entrance was cleared so the cave could become part of St. Paul's park system, and opened for "amusement and instruction." Plans called for a stairway from the blufftop to the entrance, and the installation of electric lights. These plans never materialized. Vandalism and the railroad's need for more land closed the cave once more. In 1976 a massive steel door was placed at the cave's present entrance.

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Crosby Park: Floodplain Forest, Backwater Sanctuary

Nestled along the north side of the Mississippi River across from its confluence with the Minnesota River, Crosby Farm Regional Park is an oasis for plants and wildlife. As a floodplain forest and river backwater, it represents an ecosystem that is vital to the life of the Mississippi River. Ecological restoration efforts aim to ensure its preservation.

A Farm Becomes a Park

Beginning in 1858 the area now known as Crosby Farm Regional Park was farmland operated by Thomas Crosby and his family. On their 360 acres of fertile bottomlands, the Crosbys raised cattle, horses, pigs, chickens, oats, wheat, hay, potatoes and apples. Although the land was sold by the Crosbys in the early 1900s, farming on it continued through the 1950s.

The area was first proposed for park land in 1887 by landscape architect Horace Cleveland, who considered "the jewel of the region [to be] the Mississippi River and [its] picturesque natural shoreline." Cleveland's dream of a river corridor park was fulfilled in the early 1960s when the area was dedicated to be left in a natural state for recreational purposes. Crosby Park, now managed by St. Paul Parks and Recreation, features ten miles of trails from which visitors can explore a river floodplain preserve.

Photo above: Floodplain forest in Crosby Park.
Photo: L. Torstenson, Mississippi National River and Recreation Area

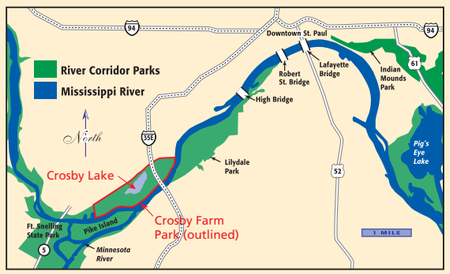
Floodplain Forest

Floodplains — lands adjacent to rivers that are periodically covered with floodwater — support trees and other plants that are adapted to cycles of rising and receding water. Rising waters in springtime bring nutrients, soils, and new life to these lands. As floodwaters recede, cottonwood, silver maple and willow seeds quickly sprout on freshly exposed soil. Eventually, cottonwoods are outcompeted by shade-tolerant trees like hackberry and elm. Other floodplain trees include black and green ash, black willow and box elder.

The floodplain forest understory is usually sparse and open. Vines like river grape and Virginia creeper wind their way into the canopy on supporting trees. Windrows of dead trees left by receding waters provide wildlife cover. The Crosby Park forest joins with other contiguous parks to provide a valuable habitat and travel corridor for wildlife such as deer, fox, raccoons, and migratory and resident birds.

Crosby Lake, a Backwater Sanctuary

The flood pulse, or annual rise and fall in water level, is the "heartbeat" of the river that rejuvenates backwater lakes and marshes as well as the river itself. During high waters, 48-acre Crosby Lake and surrounding wetlands often become part of the Mississippi. Fish species move freely between the waters, expanding their feeding, spawning and hiding areas. Receding waters concentrate small fish in the backwaters, providing feeding opportunities for larger fish, herons and egrets. Frogs utilize short-lived ponds to lay their eggs. Waterfowl nest along the shores and in tree cavities.



Location of Crosby Park along Mississippi River

Photo at left: White water lily in Crosby Lake.

Photo above: Purple loosestrife in Crosby Lake.

Photo at right: Volunteer loosestrife puller.
All three photos: Lyndon Torstenson, Mississippi National River and Recreation Area

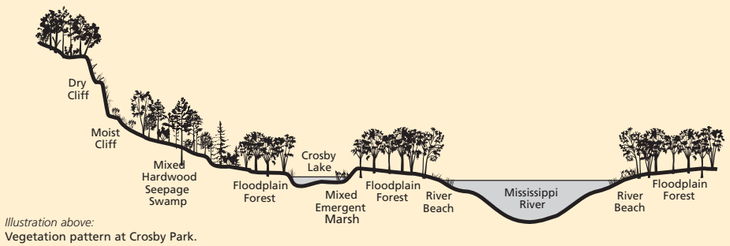


Illustration above:
Vegetation pattern at Crosby Park.
Illustration: Tom Klein, Minnesota Department of Natural Resources

Exotic Species and Restoration

Invasive, exotic (non-native) plants such as purple loosestrife, garlic mustard and common buckthorn threaten Crosby Park's diversity and habitat value. Without natural controls, these exotic species from Europe and Asia outcompete native plants. They degrade wetlands and woodlands by reducing plant diversity and replacing plants that have high wildlife value. Purple loosestrife can rapidly replace native wetland species like cattail, arrowhead and burr-reed. Buckthorn replaces native trees in the forest understory, while garlic mustard outcompetes forest herbaceous ground cover.

Control of exotics is a costly, labor-intensive and lengthy process. City crews and volunteers work annually to pull and cut loosestrife and buckthorn before new seeds are released. Through restoration efforts such as these, this "jewel" in the Mississippi floodplain will continue to provide sanctuary to plants, wildlife and people alike.

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Kaposia: Dakota Village on the Mississippi River

Up to 400 Mdewakanton Dakota Indians lived in the seasonal village of Kaposia during the early 1800's. Also known as Little Crow's village, it was situated on the banks of the Mississippi River in the vicinity of present-day St. Paul. To Kaposia's residents, the river and its surrounding land held both practical and spiritual importance.

Kaposia

Kaposia was first located on the east bank of the Mississippi River on a low terrace below the bluff. It was established after 1750 by a group of Mdewakanton Dakota whose succession of chiefs were each known as Little Crow. The name Kaposia is said to refer to the "light ones" living there who traveled swiftly and often. The village was relocated to the west side of the river as the result of the Treaty of 1837.

Lithograph above: "Little Crow's Village," about 1848. *Artist: Henry Lewis, from* Das Illustrirte Mississippithal, *courtesy Minnesota Historical Society.*

Watercolor drawing above: "Dacotah Village," by Seth Eastman. While often identified as depicting Kaposia, the actual village portrayed is uncertain. *Courtesy W. Duncan MacMillan.*

Village Life Along "Haha Wakpa"

The Mississippi River, known as "Haha Wakpa" (river of the falls) to the Dakota, provided Kaposia residents with water for drinking and bathing, plant and animal foods, rich soil for gardens, and a "highway" for transportation. Bottomland gardens provided corn, beans, tomatoes, squashes and melons, while the river itself provided fish, muskrat and beaver. The river transportation system connected these "big canoe people" and their sources of sustenance.

The Mdewakantons resided in Kaposia mainly during the warmer months of the year, and village life responded to the seasons. The breakup of ice and running of sap marked the return to the village in spring, when sugar-making parties were formed. Hunting parties sought game such as rabbits, fowl, deer, and buffalo. Seeds, roots, berries and other plants were collected in season, the most important being wild rice. Foods were dried for preservation. Dancing, music and games such as the challenging sport of lacrosse were regular parts of life. The "corn feast dance" celebrated the fall harvest. After the first hard frost the band would separate into smaller groups of one to four families, with most seeking out sheltered creek valleys for the winter.

Photo at right: Taoyateduta, known also as Little Crow, led the Kaposia band during a time of increasing contact with European immigrants and enormous changes for Dakota people. He was photographed by Julian Vannerson and Samuel Cohner in 1858 in Washington, D.C. *Photo courtesy Smithsonian Institute.*

Summer Lodges

About a dozen permanent bark houses provided summer shelter at Kaposia. These structures were built of a frame that may have been white pine or elm, and covered with elm bark. While of various sizes, most dwellings could house more than two dozen people. Outside the entrances large platforms were constructed for food drying, storage, and sleeping on hot summer nights. Inside, platforms covered by skins or rush mats were used for sitting and sleeping. Mobile tepees covered with buffalo hides were also used as shelters at Kaposia.

Locations of Kaposia along Mississippi River

What Became of Kaposia?

The Treaty of Mendota required the Kaposia Mdewakantons to move from the Mississippi River to reservation land along the Minnesota River, which they did in the spring of 1854. Kaposia descendants are now found principally at Santee, NE, Flandreau, SD, Shakopee, MN, and Prairie Island, MN, and include dispersed Wahpekute Dakota.

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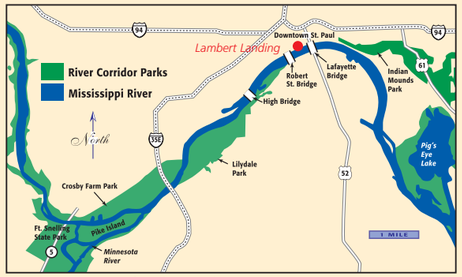
Lambert Landing: Early Immigrant Arrival Place

Known as the Lower Landing by early immigrants, Lambert Landing was once one of the busiest steamboat landings in the country. The landing served as the arrival point for vast numbers of immigrants entering Minnesota and as the principal source of supply for the new community of St. Paul until the beginning of the railroad era in the 1880s.

A Natural Stopping Place

Geography made St. Paul a natural destination, and caused a city to be born. It was here that steamboats reached the upper limit of practical navigability due to rocks, shallow water and the Falls of St. Anthony further upstream. Situated at a break in the Mississippi River's 80-foot high bluffs at the foot of present-day Jackson Street, Lambert Landing was the first and busiest St. Paul landing site encountered by steamboats traveling up the Mississippi River.



Map above: Location of Lambert Landing on Mississippi River

Illustration above right: "Jackson Street Landing 1858." This 1972 painting of the steamers Grey Eagle, Frank Steele, Jeannette Roberts, and Time and Tide, closely detailed a photograph from the earlier time. *Painting by Ken Fox; from the private collection of Capt. William D. Bowell, Sr., owner of the Padelford Packet Boat Co., Inc.*

Photo at right: Four steamers at Lower Levee, St. Paul, c. late 1850's. This photograph served as the original source from which the Ken Fox painting was created.
Photo courtesy Minnesota Historical Society.

Steamboats

For many years the Mississippi River was the principal channel of communication for the city of St. Paul with its neighbors to the east and south. Before the coming of the railroads, the first arrival of steamboats each spring was a great event for St. Paul citizens who often responded with standing ovations.

By the mid 1850s tens of thousands of immigrants, attracted by the promise of new and prosperous lives in Minnesota, were traveling the Mississippi River on steamboats to Lambert Landing. The number of steamboat arrivals grew from 256 in 1854, to 1068 in 1858, the year St. Paul became the capitol of the new state of Minnesota. Each steamboat carried on average several hundred passengers. By the 1870s, however, the steamboat heyday was past and immigrant travel to Minnesota shifted to overland transport, generally the railroad.

Modernization

The landing officially became known as "Lambert Landing" in 1937, upon its reconstruction by the Works Progress Administration as a revival of St. Paul's riverfront. It was named after Colonel George Lambert, a prominent figure in the crusade to modernize navigation on the Upper Mississippi River. In the 1950s most of the landing was removed for the construction of Warner Road.

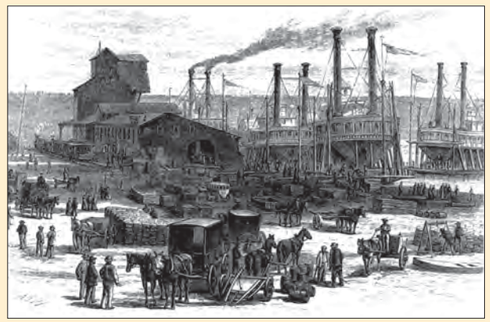


Illustration above: "View at the Levee," St. Paul, c. 1864. Artist unidentified. Railroad builder James J. Hill's first enterprise, the Transfer Warehouse, appears in background at left. *Courtesy Minnesota Historical Society.*

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Fountain Cave: St. Paul's Birthplace by the River

While noteworthy as a natural phenomenon that contained a "crystal" stream, Fountain Cave derives historical significance from its role as a starting place for a great city.

Beginning of a City

During the past 10,000 years Native Americans often inhabited sites in the area of present-day St. Paul. However, Fountain Cave, located on the "east bank" (north side) of the Mississippi River between today's Drake and Randolph Streets, may be considered the birthplace of modern St. Paul, since it was this site that attracted the first collection of immigrant settlers to the present-day city. The site's first structure was a log cabin erected by Pierre "Pig's Eye" Parrant in June, 1838. Several squatters evicted from the Fort Snelling military reservation soon joined Parrant around Fountain Cave, including Abraham Perry, a Swiss watchmaker, and Benjamin and Pierre Gervais, French Canadian fur traders.

The Cave

Estimated to have been 1,150 feet in length in the 1880s, Fountain Cave is presumed to have been Minnesota's longest natural sandstone cave. The cave formed as water from a rare sinking stream drained through it toward the river, eroding the soft sandstone. Inside the arched entrance-way was a large winding hall measuring about 150 feet in length, 15 feet in width, and from 8 to 16 feet in height. A narrow passage led from the entrance hall to a beautiful circular room measuring about 50 feet in diameter.

"The entrance to the cave is at the bottom of a circular bluff... Descending into this basin we suddenly find ourselves in a spacious room...arched overhead... The floor is a horizontal plane of sandstone. About its center glides a pretty rivulet of transparent water from which the cave takes its name, and which is heard flowing through the next room in gentle ripples; and far in the interior, out of sight , is heard the sound of a rumbling cascade. The whole interior of this cave is composed of pure white sandstone, resembling loaf sugar, which readily yields to the knife, and is constantly crumbling off."
(E. S. Seymour, "Sketches of Minnesota," 1850)

Photo at right: Mouth of Fountain Cave, c. 1870. The stream flowing from the cave gave Fountain Cave its name.
Photo: J. Carbutt, Chicago, IL., Minnesota Historical Society.

Below: Location of Fountain Cave near Mississippi River

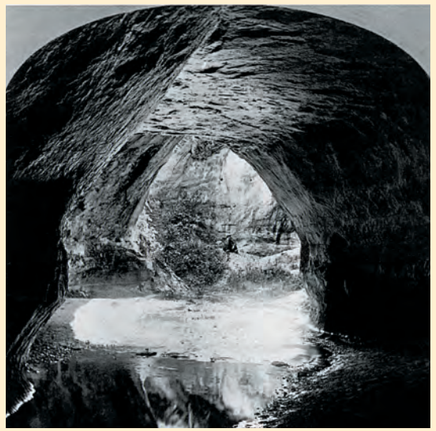

Photo above: Looking out of Fountain Cave, c. 1867. This image is from a stereoscopic post card that advertised the cave as a tourist destination.
Photo: Minnesota Historical Society.

Illustration below: Pencil and watercolor illustration of Fountain Cave, created by an unknown artist around 1850. It is the oldest known graphic representation of a Minnesota cave. Markings can be seen etched into the soft white sandstone cliffs around the cave's entrance.
Source: Minnesota Historical Society.

"Marble Temple"

A popular tourist destination from 1850 to 1880, Fountain Cave was compared to a "marble temple" and its clear stream to a "shower of diamonds." German geographer Johann Kohl proclaimed the cave a "painter's dream." It was fashionable for St. Paul residents to visit the cave for its cool air and cold water. In 1852 a pavilion opened near the cave's entrance, offering ice cream and lights for exploration, and making Fountain Cave the earliest known commercial cave in the Midwest.

In 1879 Fountain Cave was featured in the "Tourists' Guide to the Health and Pleasure Resorts of the Golden Northwest" with a picture showing elegantly dressed visitors with top hats and walking sticks. Another travel guide depicted boats inside the cave, though Fountain Creek was not navigable.

What Became of the Cave?

A variety of human activities led to the deterioration of Fountain Cave. In 1880 a nearby railroad facility began discharging its sewage and storm water through Fountain Cave. The flow of sewage impacted the cave's value as a tourist attraction. By the late 1800's, development above the cave, notably the filling of wetlands for residential development and the plugging of the sinkhole at which the creek entered the cave, severely reduced the flow of Fountain Creek. Subsequently, the creek became too sluggish to flush debris, which then accumulated at the entrance to the cave. In 1960 the cave's entrance was buried during construction of Shepard Road, however the remainder of the cave presumably still exists.

Contact us:

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Little Italy: A Floodplain Neighborhood

The "Upper Levee" along the Mississippi River was the center of Italian culture in St. Paul from the 1880s to the middle of the 1900s. Known as "Little Italy," this neighborhood lived intimately with the river.

Community Beneath a Bridge

In the 1880s, Italian immigrants joined German and Polish-born squatters on the swampy flats of the Upper Levee, between present day Chestnut Street and the High Bridge. The settlers built shacks from scrap lumber, tin and tarpaper, and elevated them on piles to prevent spring floods from entering. Eventually, as the Upper Levee was built up with refuse from the city, the Italians bought titles to the land and built more substantial houses.

The river figured daily in the life of Little Italy's residents. An early resident named Guiseppe recalled, "The water in the Mississippi was clear and shallow. Harriet Island was a popular boating and picnic beach reached by row boats from the Levee." Women washed clothes in the river, and boys dove from log booms. Fish were netted and sold commercially in the city. But by the early 1900s, the river had become very polluted and carried a foul stench; the river became more nuisance than asset.

While surrounded by a noisy, bustling city, Little Italy had a rural character in the early 1900s. Ducks, chickens and goats were quite common, and most residents had gardens where they grew tomatoes, endive, peppers, zucchini, and other vegetables. Early residents obtained their water from a nearby spring.

Photo above: Little Italy as it appeared around 1889. Located on the Mississippi River's Upper Levee below the High Bridge, this isolated Italian community survived for over half a century. ***Photo: Minnesota Historical Society.***

Photo at left: This 1938 portrait depicts one of several families that resided in Little Italy. Most of the families living in Little Italy originated from two small towns in southern Italy. ***Photo: Minnesota Historical Society.***

The Italian Immigrants

Most of the Italians living in Little Italy had been farmers who left Italy because of land shortages, malaria, droughts, and high taxes. Employment opportunities attracted them to the growing city of St. Paul. Many of the men were employed by the railroad bordering their community. The life of a railroad laborer was difficult and working conditions were harsh. The men typically worked ten or more hours a day for a daily pay of approximately $1.50. Injury and death from explosions, cave-ins, exposure, and train collisions were not uncommon.

Location of Little Italy along Mississippi River

Photo above: "Governor" Todora and Mrs. Todora rowed through the streets of Little Italy during the flood of 1952.
Photo: Minnesota Historical Society.

Demise of Little Italy

The Upper Levee community was subjected to frequent springtime floods, but its residents were generally able to endure. In 1952, however, the Mississippi River breached the dike, forcing the evacuation of most residents and causing structural damage to their homes. This flooding prompted the City of St. Paul to rezone the area for industrial use and to allow for the construction of Shepard Road. The last residents were evicted in 1959 despite their protests. Many of the displaced residents resettled on St. Paul's East Side.

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Indian Burial Mounds: Sacred Resting Place

High bluffs along the Mississippi River have long served as burial sites for American Indians. The Mounds Park area in St. Paul has been used as a burial site by at least two American Indian cultures. "Hopewell" peoples are thought to have constructed the earliest mounds between 1500 and 2000 years ago. More recently, Dakota Indians, with different burial customs, also brought their dead to this place. While only six mounds now remain evident, at least 37 mounds once stood nearby.

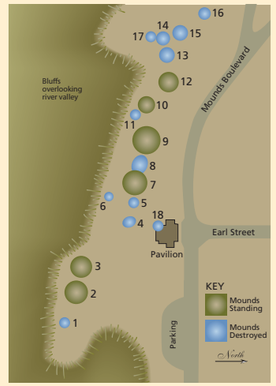
Hopewell Culture and Mounds

The name "Hopewell" is used to refer to an extensive network of Indian groups once centered in eastern North America. It is not known what the people called themselves. This network apparently flourished for 700 years or more. As many as forty offshoots have been attributed to Hopewell peoples, including the Dakota.

Large geometric earthworks and conical mounds are associated with the Hopewell. They are also recognized for their skilled artisans, who fashioned copper implements, masks and figurines, as well as fine pottery and stone tools. Such work was traded widely and was sometimes placed into mounds along with the ashes of the deceased.

While there was great diversity in Hopewell burial mound-building customs, a distinct internal structure has generally been noted. At the center was a low, circular clay platform. In the concave top of the platform were ashes and cremated human remains, along with pottery, spear points and various implements. The platform was covered by earth, which in turn was covered with alternating layers of sand and earth. The entire mound was capped with a thick layer of gravel and pebbles.

Watercolor drawing above: "Indian Burial Ground," by Seth Eastman. The site depicted here was seven miles above Fort Snelling along the Minnesota River. It served three villages of Mdewakanton Dakota.
Courtesy W. Duncan MacMillan.



Graphic above: Group of eighteen mounds surveyed in 1862 at site of Indian Mounds Park. Six of these mounds remain standing today. Additional mounds were located at nearby Dayton's Bluff.

Graphic above: Cross section showing construction of typical Hopewell mound. "A" = artifacts and cremated remains.
By Squier and Davis, 1847, Smithsonian Institution.

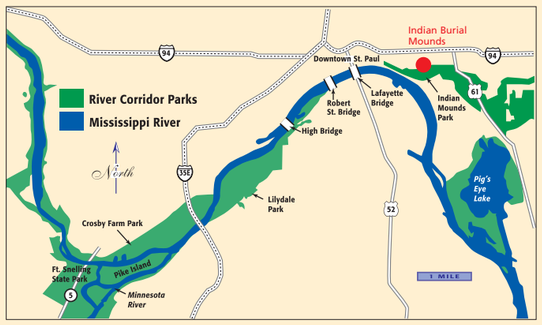
Drawing above: "Dakota Burial Ground, on plateau near the mouth of the Minnesota River" by Seth Eastman.
Courtesy of Edward E. Ayer Collection, The Newberry Library, Chicago.

Dakota Burial and Passage

The Dakota wrapped their dead in a robe or blanket and placed them on burial scaffolds. The scaffolds allowed for a continuation of life through birds' consumption of the flesh.
It also prepared the bones for later burial. After one year the bones were bundled in a buffalo skin and placed into a mound. With the bones might be placed other objects that had value and utility in the person's life – a knife, pipe, bow and arrow, sack of food, shells, or even a horse or canoe. At the Mounds Park site, Dakota may have inserted burial bundles into mounds constructed by Hopewell, or they used mounds they themselves constructed.

By traditional Dakota belief, there is no real death, but rather a journey, and continuation of life. A journey of three days is made to a female "gatekeeper" or "the old one," to whom one's life must be made accountable in order to pass on. After one year, there is a remembrance feast and give-a-way based on the preferences of the deceased. While long term religious persecution severely impacted the Dakota and their customs, many traditions associated with burial are still observed.

Burial mounds are places to be respected for the spirits of those that have passed. It is unlawful to disturb these areas.



Location of Indian Burial Mounds near the Mississippi River

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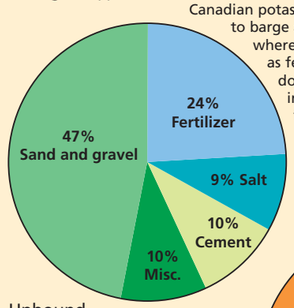
“Working Mississippi”: Moving Goods on the River

The Mississippi River provides Minnesota with a transportation link to the rest of the world. Nearly 7% of U.S. grain exports are carried by barge from the St. Paul area, traveling down the river to the Gulf of Mexico on their route to foreign destinations. The location of the Twin Cities at the upper end of the “stairway of water” created by the lock and dam system allows Minneapolis and St. Paul to serve as a major connection for the movement of bulk products in the Midwest.

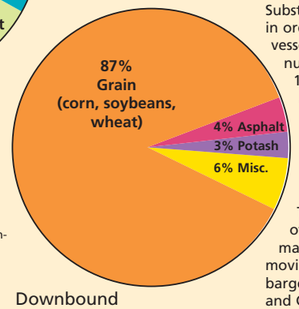
What’s Moving on the River?

A wide range of bulk commercial products, or commodities, travels up and down the Mississippi River. Principal upbound commodities in the Twin Cities are led by sand and gravel. Originating from mines on Grey Cloud Island in Cottage Grove, MN, sand and gravel are used in construction and road building. Fertilizer arrives from Florida for application in agriculture and lawn care. Salt from Louisiana is used on roads and in water softeners. Cement for construction is shipped upstream from Iowa. Other bulk commodities carried upriver include slag (used in asphalt shingles), coal, caustic soda (used in industrial and food processes), light oil, liquid ammonia, molasses, steel, pipe and twine.

Grain accounts for the vast majority of downbound tonnage. Eight million tons of Minnesota’s corn, soybeans and wheat is shipped annually by barge to New Orleans for export to destinations around the world. Liquid asphalt for roads and roofing is shipped down-river from Twin Cities oil refineries. Canadian potash is transferred from rail to barge and carried to locations where it is distributed for use as fertilizer. Other downbound commodities include petroleum coke for power generation, scrap metal for reprocessing, petroleum oil, sunflower oil, molasses and flyash.



Upbound Commodities



Downbound Commodities

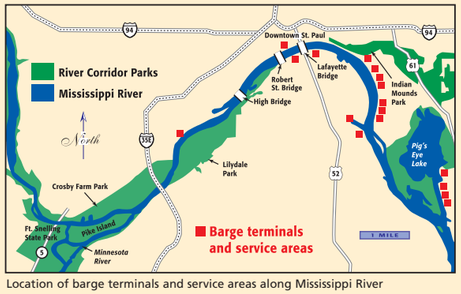
Illustrations above and right: Principal commodities, or bulk commercial goods, transported upstream (upbound) and downstream (downbound) by barge on the Mississippi River in 1999.

Stairway of Water

Substantial changes have been made to the Mississippi River in order to accommodate modern barges and other large river vessels. The river was once shallow, swift and broad, with numerous shifting sandbars, riffles and islands. Since the 1930’s the U.S. Army Corps of Engineers has maintained a nine-foot minimum channel depth through a series of twenty-nine “pools” (impoundments created by dams) between St. Louis and Minneapolis. Locks (large chambers in which water may be raised or lowered) allow boats to move up or down from one pool to another, acting as a “stairway” for both large and small watercraft.

The Twin Cities’ location at the upper end of the “stairway of water” has resulted in Minneapolis-St. Paul serving as a major connecting terminal for all kinds of bulk commodities moving in the Midwest. Rail and truck transportation links barges with product origins and destinations in the Dakotas and Canada as well as Minnesota.

Photo above: a 15-barge tow moving on Mississippi River near Lansing, Iowa. *Photo: L. Nicklay, Corps of Engineers, St. Paul District.*



Location of barge terminals and service areas along Mississippi River

Photo above: Deck hand working through lockage at Lock and Dam #1 in Minneapolis. *Photo: J. Korte, Mississippi National River and Recreation Area.*

Barges and Towboats

Each barge has a carrying capacity equal to 60 semi trailers. A standard barge is 200 feet long, 35 feet wide, and when loaded to its 1500-ton capacity needs a nine-foot depth of water to float. Barges are cabled together into a “tow,” which can be longer than three football fields. A standard tow of 15 barges can be pushed by a single towboat. A towboat may be 150 feet long, four stories high, and 6000 horsepower.

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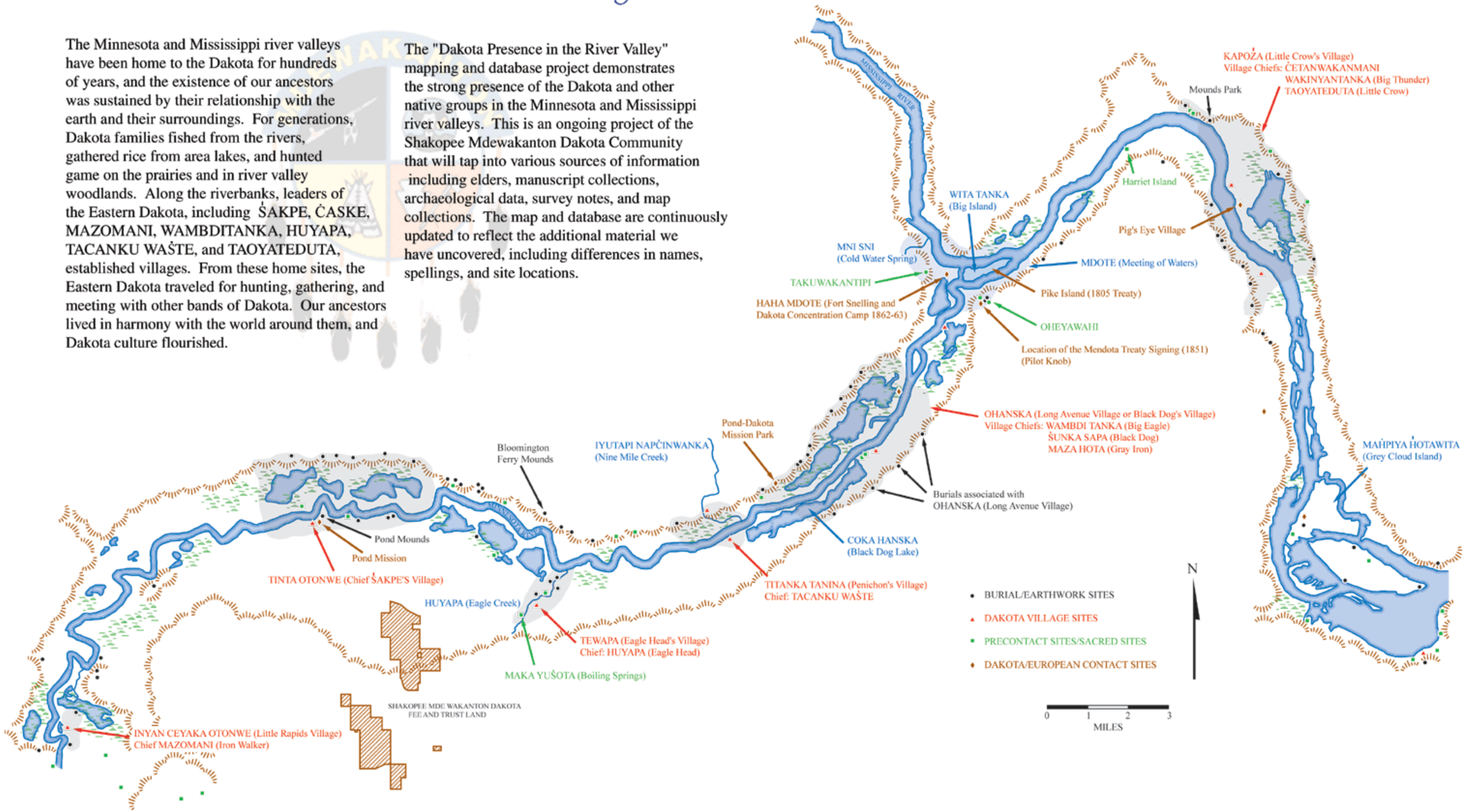
Dakota Presence in the River Valley

The Minnesota and Mississippi river valleys have been home to the Dakota for hundreds of years, and the existence of our ancestors was sustained by their relationship with the earth and their surroundings. For generations, Dakota families fished from the rivers, gathered rice from area lakes, and hunted game on the prairies and in river valley woodlands. Along the riverbanks, leaders of the Eastern Dakota, including ŠAKPE, ČASKE, MAZOMANI, WAMBDITANKA, HUYAPA, TACANKU WAŠTE, and TAOYATEDUTA, established villages. From these home sites, the Eastern Dakota traveled for hunting, gathering, and meeting with other bands of Dakota. Our ancestors lived in harmony with the world around them, and Dakota culture flourished.

The "Dakota Presence in the River Valley" mapping and database project demonstrates the strong presence of the Dakota and other native groups in the Minnesota and Mississippi river valleys. This is an ongoing project of the Shakopee Mdewakanton Dakota Community that will tap into various sources of information including elders, manuscript collections, archaeological data, survey notes, and map collections. The map and database are continuously updated to reflect the additional material we have uncovered, including differences in names, spellings, and site locations.



For more information about this project or to comment, please contact us at: Shakopee Mdewakanton Sioux (Dakota) Community,
Cultural Resources Department, 2330 Sioux Trail NW, Prior Lake, MN 55372, E-mail: culturalresources@ccsmdc.org

Minnesota Academic Standards: Interface with Big River Journey

NOTE: All grade levels within the Minnesota State Standards include a strand titled "The Nature of Science and Engineering." This strand is not intended to be taught separately, but as a process for teaching the other standards. Activities below can be modified slightly to include the appropriate grade level standards for the strand.

Big River Teacher's Guide Classroom Activities	Grade Level	Strand	Sub-Strand	Standard Understand that…	Benchmarks (ex.)
Water Cycle: Imagine!	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	2. Interdependence Within the Earth System	3. Water circulates through the earth's crust, oceans and atmosphere in what is known as the water cycle.	1. Identify where water collects on Earth, including atmosphere, ground, and surface water, and describe how water moves through the Earth system using the processes of evaporation, condensation, precipitation.
Water Cycle: The Incredible Journey	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	2. Interdependence Within the Earth System	3. Water circulates through the earth's crust, oceans and atmosphere in what is known as the water cycle.	1. Identify where water collects on Earth, including atmosphere, ground, and surface water, and describe how water moves through the Earth system using the processes of evaporation, condensation, precipitation.
	6	II. PHYSICAL SCIENCE	1. Matter	2. Substances can undergo physical changes which do not change the composition or the total mass of the substance in a closed system.	3. Use the relationship between heat and the motion and arrangement of particles in solids, liquids, and gases to explain melting, freezing, condensation, and evaporation.
	5	**LANGUAGE ARTS** II. WRITING	B. Elements of Composition	The student will engage in a writing process, with attention to organization, focus, and quality of ideas, audience and a purpose.	1. Write topic sentences. 2. Create multiple paragraph compositions. 3. Use composing processes.
Geology: Create Sedimentary Strata	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	1. Earth Structure and Processes	3. Rocks are Earth materials that may vary in composition.	1. Recognize that rocks may be uniform or made of mixtures of different materials.
	5	III. EARTH AND SPACE SCIENCE	1. Earth Structure and Processes	2. The surface of the Earth changes. Some changes are due to slow processes and some changes are due to rapid processes.	1. The student will explain how, over time, rocks weather and combine with organic matter to form soil. 2. The student will explain how slow processes, such as water erosion, and rapid processes,, such as landslides, and volcanic eruptions, form features of the Earth's surface.
Geology: Make Your Own Fossil	7	**SCIENCE** IV. LIFE SCIENCE	3. Evolution in Living Systems	2. Individual organisms with certain traits in particular environments are more likely than others to survive and have offspring.	1. Explain how the fossil record documents the appearance, diversification and extinction of many life forms. 2. Use internal and external anatomical structures to compare and infer relationships between living organisms as well as those in the fossil record.

(continued) Geology: Make your own Fossil	8	III. EARTH AND SPACE SCIENCE	1. Earth Structure and Process	3. Students will understand that rocks and rock formations indicate evidence of the materials and conditions that produced them.	4. Recognize that extinction is a common even t and it can occur when the environment changes and a population's ability to adapt is insufficient to allow its survival. 1. Interpret successive layers of sedimentary rocks and their fossils to infer relative ages of rock sequences, past geologic events, changes in environmental conditions, and the appearance and extinction of life forms.
Aquatic Bugs & Their Feeding Habits	3	**SCIENCE** IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Compare how the different structures of plants and animals serve various functions of growth, survival, and reproduction. 2. Identify common groups of plants and animals using observable physical characteristics, structures and behaviors.
	3	IV. LIFE SCIENCE	3. Evolution in Living Systems	2. Students will understand that offspring are generally similar to their parents, but may have variations that can be advantageous or disadvantageous in a particular environment.	1. Give examples of likenesses between adults and offspring in plants and animals that can be inherited or acquired. 2. Give examples of differences among individuals that can sometimes give an individual an advantage in survival and reproduction.
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
Macro invertebrate Mayhem	5	**SCIENCE** IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems.	1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs. 2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.

Birds, Beaks, and Adaptations	3	**SCIENCE** IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Compare how the different structures of plants and animals serve various functions of growth, survival, and reproduction. 2. Identify common groups of plants and animals using observable physical characteristics, structures and behaviors.
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	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
River Ecosystem: Web of Life Game	3	**SCIENCE** IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Compare how the different structures of plants and animals serve various functions of growth, survival, and reproduction. 2. Identify common groups of plants and animals using observable physical characteristics, structures and behaviors.
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	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems.	1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs. 2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.

Build an Aluminum Foil Boat	6	**SCIENCE** I. THE NATURE OF SCIENCE AND ENGINEERING	2. The Practice of Engineering	1. Students will understand that engineers create, develop and manufacture machines, structures, processes and systems that impact society and may make humans more productive.	1. Identify a common engineered system and evaluate its impact on the daily life of humans. 2. Recognize that there is no perfect design and that new technologies have consequences that may increase some risks and decrease others. 3. Describe the trade-offs in using manufactured products in terms of features, performance, durability, and cost. 4. Explain the importance of learning from past failures, in order to inform future designs of similar products or systems.
	6	I. THE NATURE OF SCIENCE AND ENGINEERING.	2. The Practice of Engineering	2. Students will understand that engineering design is the process of devising products, processes and systems that address a need, capitalize on an opportunity, or solve a specific problem.	1. Apply and document an engineering design process that includes identifying criteria and constraints, making representations, testing and evaluation, and refining the design as needed to construct a product or system that solves a problem.
The Island Watershed Activity	4-8	**SOCIAL STUDIES** V. GEOGRAPHY	B. Maps and Globes	The student will make and use maps to acquire, process, and report on the spatial organization of people and places on Earth.	1. Students will create a variety of maps to scale.
			C. Physical Features and Processes	The student will use basic terminology describing basic physical and cultural features of continents.	1. Students will locate and describe major physical features and analyze how they influenced cultures and civilizations.
	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	2. Interdependence Within the Earth System	1. The students will understand that water circulates through the Earth's crust, oceans, and atmosphere in what is known as the water cycle.	1. Identify where water collects on Earth, including atmostphere, ground and surface water, and describe how water moves through the Earth system using the processes of evaporation, condensation, and evaporation.
			3. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems	1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie, or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs.

Non-point Source Pollution	4	**SCIENCE** I. THE NATURE OF SCIENCE AND ENGINEERING	2. Practice of Engineering	1. Engineers design, create and develop structures, processes and systems that are intended to improve society and may make humans more productive.	1. Describe the positive and negative impacts that the designed world has on the natural world as more and more engineered products and services are created and used.
	5	III. EARTH AND SPACE SCIENCE	4. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
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		IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.
The Enviroscape	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	4. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality. 4. Understand that different models can be used to represent natural phenomena and these models have limitations about what they can explain.
	5	I. THE NATURE OF SCIENCE AND ENGINEERING	1. The Practice of Science	1. Science is a way of knowing about the natural world, is done by individuals and groups, and is characterized by empirical criteria, logical argument and skeptical review.	
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems.	1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs. 2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.

(continued) The Enviroscape	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.
My Street is a River	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	3. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
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	6	I. THE NATURE OF SCIENCE AND ENGINEERING	2. The Practice of Engineering	1. Students will understand that engineers create, develop and manufacture machines, structures, processes and systems that impact society and may make humans more productive.	1. Identify a common engineered system and evaluate its impact on the daily life of humans. 2. Recognize that there is no perfect design and that new technologies have consequences that may increase some risks and decrease others. 3. Describe the trade-offs in using manufactured products in terms of features, performance, durability, and cost. 4. Explain the importance of learning from past failures, in order to inform future designs of similar products or systems.

(continued) My Street is a River	6	I. THE NATURE OF SCIENCE AND ENGINEERING	2. The Practice of Engineering	2. Students will understand that engineering design is the process of devising products, processes and systems that address a need, capitalize on an opportunity, or solve a specific problem.	1. Apply and document an engineering design process that includes identifying criteria and constraints, making representations, testing and evaluation, and refining the design as needed to construct a product or system that solves a problem.
Map the Mississippi Watershed	4-8	**SOCIAL STUDIES** V. GEOGRAPHY	A. Concepts of Location B. Maps and Globes C. Physical Features and Processes E. Essential Skills	The student will identify and locate major physical and cultural features that played an important role in the history of the United States. The student will make and use maps to acquire, process, and report on the spatial organization of people and places on Earth. The student will use basic terminology describing basic physical and cultural features of continents. The student will use maps, globes, geographic systems and other sources of information to analyze the nature of places at a variety of scales.	1. Students will locate and name all 50 states, mountain ranges, major river valleys, state capitols and cites. 1. Students will create a variety of maps to scale. 1. Students will locate and describe major physical features and analyze how they influenced cultures and civilizations. 1. Students will demonstrate the ability to obtain geographic information from a variety of print and electronic sources.
Map the River in the Twin Cities	4-8	**SOCIAL STUDIES** V. GEOGRAPHY	A. Concepts of Location B. Maps and Globes C. Physical Features and Processes D. Interconnections	The student will identify and locate major physical and cultural features that played an important role in the history of Minnesota. The student will make and use maps to acquire, process, and report on the spatial organization of people and places on Earth. The student will identify and locate geographic features associated with the development of Minnesota. The student will give examples that demonstrate how people are connected to each other and the environment.	1. Students will locate major Minnesota ecosystems, topographic features, continental divides, river valleys, and cities. 1. Students will create a variety of maps to scale. 3. Students will identify physical features that either hindered or promoted the development of the fur trade and the rapid settlement in the early 19th century. 2. Students will analyze how the physical environment influences human activities.
Lessons from a Landscape **(continued)**	4 5	**SCIENCE** III. EARTH AND SPACE SCIENCE IV. LIFE SCIENCE	3. Human Interactions with Earth Systems 1. Structure and	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems. 1. Students will understand that living things are diverse with	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality. 1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.

Lessons from a Landscape	5	IV LIFE SCIENCE	Function in Living Systems. 2. Interdependence Among Living Systems.	many different characteristics that enable them to grow, reproduce and survive. 1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs. 2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.
	4-8	**SOCIAL STUDIES** V. GEOGRAPHY	B. Maps and Globes	The student will make and use maps to acquire, process, and report on the spatial organization of people and places on Earth.	1. Students will create a variety of maps to scale.
History at Fort Snelling	4-8	**HISTORY** I. U.S. HISTORY	E. Growth and Westward Expansion, 1801-1861	The student will demonstrate knowledge of western expansion, conflict, and reform in America.	1. Students will examine the processes that led to the territorial expansion of the United States, including wars and treaties with foreign nations and Indian nations,…Louisiana Purchase… 2. Students will analyze the impact of inventions and technologies on life in America…
	4-8	II. MINNESOTA HISTORY	C. Early Settlement and Statehood, 1810-1860	The student will know and understand the factors that led to rapid settlement of Minnesota in the 19th century and the changes the new Minnesotans brought with them.	1. Students will explain why early settlers came to Minnesota and analyze their impact on political, cultural, and physical landscapes.
Surf the Mississippi	4-8	**SOCIAL STUDIES** I. U.S. HISTORY	E. Growth & West-ward Expansion, 1801-61	The student will demonstrate knowledge of western expansion, conflict, and reform in America.	2. Students will analyze the impact of inventions and technologies on life in America, including… the steamboat,…
	4-8	V. GEOGRAPHY	A. Concepts of Location	The student will identify and locate major physical and cultural features that played an important role in the history of the United States.	1. Students will locate and name all 50 states, mountain ranges, major river valleys, state capitols and cites.
			C. Physical Features and Processes	The student will identify and locate geographic features associated with the development of Minnesota.	3. Students will identify physical features that either hindered or promoted the development of the fur trade and the rapid settlement in the early 19th century.
			D. Interconnections	The student will give examples that demonstrate how people are connected to each other and the environment.	1. Students will identify factors that drew people to their local communities. 2. Students will analyze how the physical environment influences human activities.

The River Is a Poem	5	**LANGUAGE ARTS** II. WRITING	A. Types of Writing	The student will compose various pieces of writing.	1. The student will write in a variety of modes to express meaning, including: …e. poetry.
Big River Art Contest	4-5	**ARTS** ARTISTIC EXPRESSION	D. Visual Arts	The student will understand and use artistic processes to create, perform, and interpret art works…	1. The student will understand the following components of visual arts: a) elements, including color, line, shape, form, texture, and space; b) principles such as repetition, contrast, or balance. 2. The student will create original works of art to express specific artistic ideas.
	6-8	ARTISTIC CREATIVITY	D. Visual Arts	The student will understand and use artistic processes to create and perform…	1. The student will understand the following components of visual art: a) elements, including color, line, shape, form, texture, and space; b) principles such as repetition, contrast, or balance; d) styles, such as abstract or expressionist. 4. The student will use artistic processes to create in a variety of visual arts contexts. 5. The student will express and communicate ideas using components of visual arts. 7. The student will make and explain artistic choices in creating visual art.
Service Learning: Storm Drain Stenciling	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	3. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	III. EARTH AND SPACE SCIENCE	4. Human Interaction with Earth Systems	1. In order to maintain and improve their existence, humans interact with and influence Earth systems.	3. Compare the impact of individual decisions on natural systems.
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems.	1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs. 2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.

Waters to the Sea (CD-ROM)		**SOCIAL STUDIES**			
	4-8	II. MINNESOTA HISTORY	C. Early Settlement and Statehood, 1810-1860	The student will know and understand the factors that led to rapid settlement of Minnesota in the 19th century and the changes the new Minnesotans brought with them.	1. Students will explain why early settlers came to Minnesota and analyze their impact on political, cultural, and physical landscapes.
			E. Industrial Era, 1865-1914	The student will know and understand Minnesota's major industries and the economic, social, political, and technological changes that accompanied industrialization.	2. Students will describe the impact of industrialization on work, home, leisure life, politics, immigration, urbanization, and changes in the physical landscape.
	4-8	V. GEOGRAPHY	A. Concepts of Location	The student will identify and locate major physical and cultural features that played an important role in the history of Minnesota.	1. Students will locate major Minnesota ecosystems, topographic features, continental divides, river valleys, and cities.
			C. Physical Features and Processes	The student will identify and locate geographic features associated with the development of Minnesota.	1. Students will identify and compare and contrast the landforms, natural vegetation, climate, and systems of rivers and lakes of Minnesota with those of other parts of the United States.
			D. Interconnections	The student will give examples that demonstrate how people are connected to each other and the environment.	2. Students will analyze how the physical environment influences human activities.
		SCIENCE			
	4	III. EARTH AND SPACE SCIENCE	3. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems.	1. Students will understand that natural systems have many components that interact to maintain the living system.	1. Describe a natural system in Minnesota, such as a wetland, prairie or garden, in terms of the relationships among its living and nonliving parts, as well as inputs and outputs. 2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.

Big River Journey Learning Stations (field trip activities)	Grade Level	Strand	Sub-Strand	Standard	Benchmarks (ex.)
1: Aquatic Invertebrates	3	**SCIENCE** IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	2. Identify common groups of plants and animals using observable physical characteristics, structures and behaviors.
	3	IV. LIFE SCIENCE	3. Evolution in Living Systems	2. Students will understand that offspring are generally similar to their parents, but may have variations that can be advantageous or disadvantageous in a particular environment.	2. Give examples of differences among individuals that can sometimes give an individual an advantage in survival and reproduction.
	5	I. NATURE OF SCIENCE AND ENGINEERING	3. Interactions Among Science, Technology Engineering, Mathematics, and Society	4. Tools and mathematics help scientists and engineers see more, measure more accurately, and do things that they could not otherwise accomplish.	1. Use appropriate tools and techniques in gathering, analyzing and interpreting data.
	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems.	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
	5	IV LIFE SCIENCE	2. Interdependence Among Living Systems.	1. Students will understand that natural systems have many components that interact to maintain the living system.	2. Explain what would happen to a system such as a wetland, prairie, or garden if one of its parts were changed.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.
2: Mystery of the Disappearing Waterfall	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	1. Earth Structure and Processes	3. Rocks are Earth materials that may vary in composition.	1. Recognize that rocks may be uniform or made of mixtures of different materials.
	5	III. EARTH AND SPACE SCIENCE	1. Earth Structure and Processes	2. The surface of the Earth changes. Some changes are due to slow processes and some changes are due to rapid processes.	1. The student will explain how, over time, rocks weather and combine with organic matter to form soil. 2. The student will explain how slow processes, such as water erosion, and rapid processes,, such as landslides, and volcanic eruptions, form features of the Earth's surface.

2: Mystery of the Disappearing Waterfall (cont'd)	4-8	**SOCIAL STUDIES** V. GEOGRAPHY	C. Physical Features and Processes D. Interconnections	The student will use basic terminology describing basic physical and cultural features of continents. The student will give examples that demonstrate how people are connected to each other and the environment.	1. Students will locate and describe major physical features and analyze how they influenced cultures/civilizations studied. 1. Students will identify factors that drew people to their local communities. 2. Students will analyze how the physical environment influences human activities.
3: Adopt-A-River Crime Lab	4 4 5 5	**SCIENCE** I. THE NATURE OF SCIENCE AND ENGINEERING III. EARTH AND SPACE SCIENCE III. EARTH AND SPACE SCIENCE IV. LIFE SCIENCE	2.Practice of Engineering 4. Human Interactions with Earth Systems 4. Human Interactions with Earth Systems 4. Human Interactions with Living Systems	1. Engineers design, create and develop structures, processes and systems that are intended to improve society and may make humans more productive. 1. In order to improve their existence, humans interact with and influence Earth Systems. 1. In order to maintain and improve their existence, humans interact with and influence Earth systems. 1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Describe the positive and negative impacts that the designed world has on the natural world as more and more engineered products and services are created and used. 1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality. 3. Compare the impact of individual decisions on natural systems. 1. Give examples of beneficial and harmful human interaction with natural systems.
4: River Birds	3 3 5	**SCIENCE** IV. LIFE SCIENCE IV. LIFE SCIENCE I. NATURE OF SCIENCE AND ENGINEERING	1. Structure and Function in Living Systems. 3. Evolution in Living Systems 3. Interactions Among Science, Technology Engineering, Mathematics, and Society	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive. 2. Students will understand that offspring are generally similar to their parents, but may have variations that can be advantageous or disadvantageous in a particular environment. 4. Tools and mathematics help scientists and engineers see more, measure more accurately, and do things that they could not otherwise accomplish.	1. Compare how the different structures of plants and animals serve various functions of growth, survival, and reproduction. 2. Identify common groups of plants and animals using observable physical characteristics, structures and behaviors. 1. Give examples of likenesses between adults and offspring in plants and animals that can be inherited or acquired. 2. Give examples of differences among individuals that can sometimes give an individual an advantage in survival and reproduction. Use appropriate tools and techniques in gathering, analyzing and interpreting data.

4: River Birds (cont'd)	5	IV. LIFE SCIENCE	1. Structure and Function in Living Systems	1. Students will understand that living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	1. Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.
5: Ecosystem-Ottersystem		**SCIENCE**			
	3	IV. LIFE SCIENCE	1. Structure and Function in Living Systems	1. Living things are diverse with many different characteristics that enable them to grow, reproduce and survive.	2. Indentify common groups of plants and animals using observable physical characteristics, structures and behaviors.
	4	III. EARTH AND SPACE SCIENCE	3. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	I. NATURE OF SCIENCE AND ENGINEERING	3. Interactions Among Science, Technology Engineering, Mathematics and Society	4. Tools and mathematics help scientists and engineers see more, measure more accurately, and do things that they could not otherwise accomplish.	1. Use appropriate tools and techniques in gathering, analyzing and interpreting data.
	5	III. EARTH AND SPACE SCIENCE	1. Earth Structure and Processes	1. The students will understand that the surface of the Earth changes, some changes are due to slow processes and some changes are due to rapid processes.	2. The student will explain how slow processes, such as water erosion, and rapid processes, such as landslides, and volcanic eruptions, form features of the Earth's surface.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.
6: Riverboat Piloting		**SCIENCE**			
	5	I. NATURE OF SCIENCE AND ENGINEERING.	3. Interactions Among Science, Technology Engineering, Mathematics, and Society	The student will understand that tools and mathematics help scientists and engineers see more, measure more accurately, and do things that they could not otherwise accomplish.	1. Use appropriate tools and techniques in gathering, analyzing and interpreting data. 2. Create and analyze different kinds of maps of the student's community and of Minnesota.
	5	II. PHYSICAL SCIENCE	2. Motion	1. An object's motion is affected by forces and can be described by the object's speed and the direction it is moving.	2. Identify the force that starts something moving or changes its speed or direction of motion.
	6	II PHYSICAL SCIENCE	2. Motion	1. The motion of an object can be described in terms of speed, direction and change of position.	1. Measure and calculate the speed of an object that is traveling in a straight line.

6: Riverboat Piloting (cont'd)				2. Forces have magnitude and direction and affect the motion of objects.	1. Recognize that when the forces acting on an object are balanced, the object remains at rest or continues to move at a constant speed in a straight line, and that unbalanced forces cause a change in the speed or direction of the motion of an object. 2. Identify the forces acting on an object and describe how the sum of the forces affects the motion of the object.
A: River Artifacts	5 4-8 4-8	**SCIENCE** I. NATURE OF SCIENCE AND ENGINEERING **SOCIAL STUDIES** II. MINNESOTA HISTORY V. GEOGRAPHY	3. Interactions Among Science, Technology Engineering, Mathematics, and Society A. Pre-contact to 1650 B. Contact and Fur Trade 1600-1810 D. Interconnections	The student will understand that men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry. The student will demonstrate knowledge of Minnesota's indigenous peoples. The student will demonstrate knowledge of early explorers and fur traders in Minnesota and the impact of the fur trade on both European and Native societies. The student will describe how humans influence the environment and in turn are influenced by it.	1. Describe how science and engineering influence and are influenced by local traditions and beliefs. 1. Students will describe the evidence of the indigenous cultures in Minnesota, and make reasoned inferences from that evidence. 1. Students will describe how early explorers and fur traders affected the development of Minnesota. 1. Students will recognize changes over time in nearby landscapes, resulting from human occupation.
B: Soldier Hike	4-8 4-8 4-8	**SOCIAL STUDIES** I. U.S. HISTORY II. MINNESOTA HISTORY V. GEOGRAPHY	E. Growth and Westward Expansion, 1808-1861 C. Early Settlement and Statehood, 1810-60 C. Physical Features and Processes	The student will demonstrate knowledge of western expansion, conflict, and reform in American. The student will know and understand the factors that led to rapid settlement of Minnesota in the 19th century and the changes the new Minnesotans brought with them. The student will identify and locate geographic features associated with the development of Minnesota.	1. Students will examine the processes that led to the territorial expansion of the United States including wars and treaties with… Indian nations,… Louisiana Purchase and other land purchases, and the removal of American Indians to reservation. 1. Students will explain why early settlers came to Minnesota and analyze their impact on political, cultural, and physical landscapes. 3. Students will understand why and how the Minnesota Indian Nations negotiated treaties with the United States, and the impact of these treaties for the Ojibwe, the Dakota, and the settlers. 3. Students will identify physical features that either hindered or promoted the development of the fur trade and the rapid settlement in the early 19th Century.
C: Cultural Confluence	4-8	**SOCIAL STUDIES** I. U.S. HISTORY	A. Pre-history through 1607 B. Pre-history through 1607	The student will understand that large and diverse American Indian Nations were the original inhabitants of North America. The student will demonstrate knowledge of European exploration of the North American continent and the resulting interaction with American Indian Nations.	1. Students will compare ways of life of Indian Nations from different regions of North America. 2. Students will know and explain that interactions between American Indian tribes and European explorers had positive and negative impacts.

C: Cultural Confluence (cont'd)	4-8	II. MINNESOTA HISTORY	A. Pre-contact to 1650	The student will demonstrate knowledge of Minnesota's indigenous peoples.	1. Students will describe the evidence of the indigenous cultures in Minnesota, and make reasoned inferences from that evidence. 2. Students will explain the major historical aspects of Dakota and Ojibwe culture, social organization and history, and compare and contrast them.
			B. Contact and Fur Trade, 1600-1810	The student will demonstrate knowledge of early explorers and fur traders in Minnesota and the impact of the fur trade on both European and Native societies.	1. Students will describe how early explorers and fur traders affected the development of Minnesota. 2. Students will describe the economic and cultural… interaction between the Dakota and Ojibwe and the explorers and the fur traders.
	4-8	V. GEOGRAPHY	C. Physical Features and Processes	The student will identify and locate geographic features associated with the development of Minnesota.	2. Students will identify physical features that shaped settlement and life-ways of the Dakota and the Ojibwe and analyze their impact. 3. Students will identify physical features that either hindered or promoted the development of the fur trade and the rapid settlement in the early 19th Century.
D: Floodplain Hike	4	**SCIENCE** III. EARTH AND SPACE SCIENCE	3. Human Interactions with Earth Systems	1. Students will understand that in order to improve their existence, humans interact with and influence Earth Systems.	1. Describe how the methods people utilize to obtain and use water in their homes and communities can affect water supply and quality.
	5	III EARTH AND SPACE SCIENCE	1. Earth Structure and Processes	1. The students will understand that the surface of the Earth changes, some changes are due to slow processes and some changes are due to rapid processes.	2. The student will explain how slow processes, such as water erosion, and rapid processes, such as landslides, and volcanic eruptions, form features of the Earth's surface.
	5	IV. LIFE SCIENCE	4. Human Interactions with Living Systems	1. Students will understand that humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	1. Give examples of beneficial and harmful human interaction with natural systems.
	4-8	**SOCIAL STUDIES** V. GEOGRAPHY	C. Physical Features and Processes	The student will identify and locate geographic features associated with the development of Minnesota.	1. Students will identify and compare and contrast the landforms, natural vegetation, climate, and systems of rivers and lakes of Minnesota with those of other parts of the United States.

Websites for Teachers

Mississippi National River & Recreation Area / Park Video (20 min)
http://www.nps.gov/miss/index.htm

Teacher resources, on-line curricula, field trip & workshop opportunities
http://www.nps.gov/miss/forteachers/index.htm

National Park Service
http://www.nps.gov/

Urban Water Cycle (interactive)
http://cgee.hamline.edu/UWC/UWC-MN/ **or**
http://www.health.state.mn.us/water/urbancycle/

DNR Volunteer "Young Naturalists" series

Article on Mississippi River
http://www.dnr.state.mn.us/young_naturalists/mississippi/index.html
Click on "Teacher's Guide"

Article on Minnesota Geology
http://www.dnr.state.mn.us/young_naturalists/rockyroots/index.html
Click on "Teacher's Guide"

Article on Mussels
http://www.dnr.state.mn.us/young_naturalists/mussels/index.html

Article on The Wonder of Water
http://www.dnr.state.mn.us/young_naturalists/water/index.html
Click on "Teacher's Guide"

Grand Excursion Trunks information
http://cgee.hamline.edu/GE04Guide/

Service Learning: Watershed Action Projects
http://cgee.hamline.edu/watershed/action/projects/

Big River Journey
River Resource Contacts, 2013

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Waters to the Sea (CD-ROM) &
Internet Curricula (Rivers of Life)
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e-mail: jshepard@gw.hamline.edu
website: www.hamline.edu/gse/cgee_site

River Stewardship, Watersheds
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website: www.dnr.state.mn.us/adoptriver

River Boats
Captain Tracy Shimek
Padelford Packet Boat Co.
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e-mail: tracy@riverrides.com
website: riverrides.com

Historic Fort Snelling
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website: www.mnhs.org/places/sites/hfs

State Park Resources
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krista.jensen@state.mn.us
website:
www.dnr.state.mn.us/state_parks/fort_snelling/index.html

Service Learning: Storm Drain Stenciling
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website: fmr.org

Art Contest
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